EDITORIAL

AS this issue goes to press, the delegates and observers will have gathered at Geneva for the Administrative Radio Conference of the International Telecommunication Union. Among them is our editor, John Moyle, acting on this occasion, as an official observer-adviser with the Australian delegation and on behalf of the Wireless Institute.

All fellow amateurs will wish him well in a task which will, at various times, be interesting, onerous and tedious.

As John realised quite early, the job must involve—and has involved—a great deal more than just turning up at Geneva on the appointed date. Such an attitude might get by, on occasions, in purely local circles but certainly not in Geneva, where thousands of delegates and observers are assembled, divided by language barriers and each intent on securing the interests which he represents.

To have any impact, it has been necessary for John to study proposals and allocations at great length, to think up argument and counter-argument and to develop liaison with the Australian delegation, as well as with every possible person interested in furthering the amateur cause.

If this sounds like undue emphasis on a sectional interest it is only because such emphasis is necessary to maintain any recognition at all against the enormous pressure on ether space being exerted by other bodies.

The natural growth of accepted services presents problem enough but this present conference has to face a host of new requirements connected with missile and space activities. A whole new era lies before us and we can only guess at the events which will happen before the next scheduled conference, 11 years hence.

In the meantime, and as I write, a story in the daily paper tells of impending disaster in the Maddison Valley, Montana, U.S., where earthquakes have cracked the Hebgen Dam. Local authorities are evacuating threatened towns while workers at the dam keep watch on the damage. Says the cable, "The only communication with them is through an amateur radio operator."

As in so many other such emergencies, that vital amateur link would not have been there, had not earlier conferences had the foresight to preserve a minimum of band space for amateur working.

It would be very easy right now to crowd amateurs out of the scheme of things. But it will not be easy to regenerate them, once their leisure time has been diverted to some other hobby outside the field of electronics.

W. N. Williams

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RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

"THE WORKS" OF A JET —The face of Australia's Airline Maintenance workshops is changing as piston motors give place to prop-jets and pure jets. This is becoming an everyday scene for Qantas Engineers at Sydney's Kingsford-Smith Airport.

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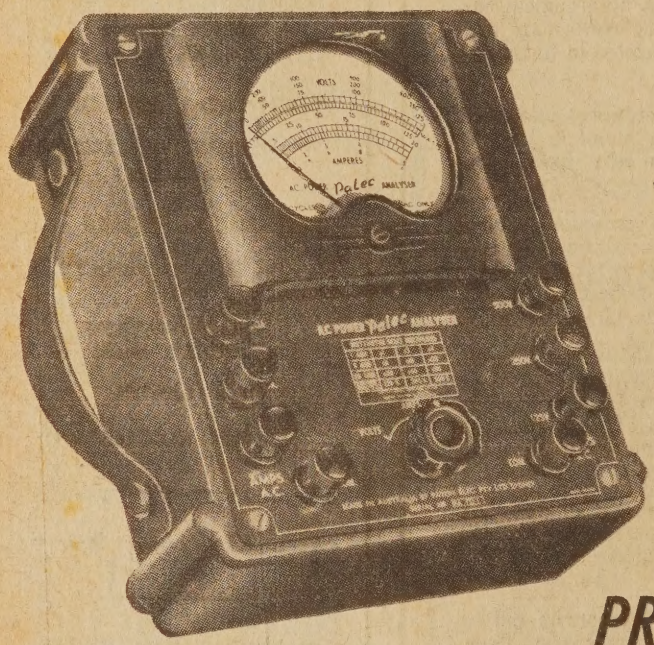

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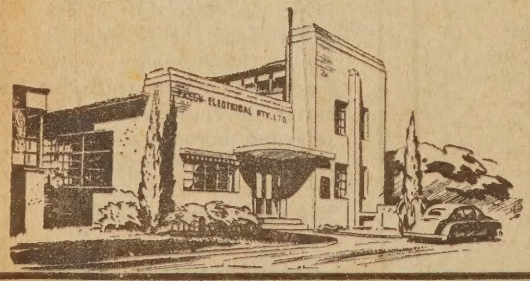

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TV CAMERA WORKS UNDER WATER

Under-water television has proved sufficiently valuable to justify the development of special equipment for use in observing damage to ships, and for general work with dams, jetties and undersea cables. This picture shows a Grundig under-water TV camera almost withdrawn from its case. The "works" are no larger than a cigar box.

Qantas House in Sydney, headquarters of Australia's international airline, now occupies this handsome building 39 years after its establishment.

Qantas Has Made Flying History

This is the story of a pioneer Australian industry whose history forms a large part of aviation development in this part of the world. From the crude and often makeshift aircraft shown herewith, Qantas has progressed until it is now equipped with the most modern used in the world today. But let us go back into the past.

FROM a 577-mile air route between two outback Queensland towns to 70,000 unduplicated route miles and the first round-the-world jet service.

From a fleet of two tiny, 60 m.p.h., 100-horsepower World War I biplanes to a fleet that includes seven 550 m.p.h., 110-ton, 40,000-horsepower Boeing 707 jet airliners, four Electra turboprops and many other aircraft.

From flying 3,000 miles in two years to flying 15 million miles a year; from flying 1 million miles in 10 years to flying 1 million miles regularly every three and a half weeks.

From a staff of three to a staff of 6,500.

From a one-room, weatherboard "head office" in a small country town, to a 16-floor, £1,300,000 head office in Sydney and branch offices all over the world.

From a company with a total paid-up capital of £6,037 to a company with £10 million capital, assets of £27 million and revenue running at more than £20 million a year.

This is the growth bridged by the 39-year history of Australia's overseas airline, Qantas—39 years that make it the oldest airline in the English-speaking world; second oldest in the world.

For the aircraft hobbyist, tracing the history of Qantas and the growth of its fleet is virtually to trace the history of commercial aviation.

The humble beginnings from which grew Qantas Empire Airways can be traced in the name Qantas itself. The name is formed from the initials of "Queensland and Northern Territory Aerial Services," the small company which has grown with the age of air travel to be one of Australia's biggest commercial enterprises.

The story begins with an old "Tin Lizzie" car shaking and rattling over impossible country in Australia's northern outback. Drivers of the protesting car were two young ex-World War I Flying Corps Lieutenants, W. Hudson Fysh and P. J. McGinness, who had been commissioned by the Australian Federal Government to survey an air route between Longreach and Darwin for the first England-Australia Air Race in 1919. The Federal Government had offered a prize of £10,000 to the first Australian to fly from England to Australia.

AERIAL PIPE DREAMS

Between rattles and bumps, the two young airmen, contrasting their recent flying experiences with this slow and bone-rattling method of travel, indulged in some pipe-dreams of an aerial service as an answer to the problem of outback travel.

A chance meeting between the airmen and a squatter named Fergus McMaster, whose car they rescued when they found it bogged in a sandy river bed, led to the foundation of Qantas. McMaster shared their enthusiasm for an outback air service. He and his grazier friends raised the money which enabled them to register "Queensland and Northern Territory Aerial Services" as a company in November, 1920. Almost from the start this rather unwieldy name was popularly abbreviated to Qantas.

Soon the new air service was operating—with two war-type biplanes capable of 60 m.p.h. and a total staff of three. One half of the "fleet" was a B.E. 2E, fitted with a R.A.F. air-cooled engine; the other was an Avro with a 100 h.p. water-cooled Sunbeam Dyak engine. The staff consisted of pilots Hudson Fysh and McGinness and an engineer named Arthur Baird.

During 1921 and 1922 the new air line flew some 3,000 miles and carried 871 passengers, mainly on joy rides. Seventy-nine taxi flights were also chartered during this period, one being the first maternity case in Australia to be taken to hospital by air, while another was the first recorded aerial turkey-shooting expedition.

The first regular air service in Eastern Australia began on November 2, 1922—between Charleville and Cloncurry. This 577-mile trip was considered too far to fly in one day because of the inland

heat, so there was an overnight stop at Longreach where Qantas then had its head office. Today, one of Qantas' new 707 jets could fly this first air route in little more than an hour.

The payload on the historic first service was 400lb (maximum payload for a Boeing 707 jet is 34,000lb) and 108 letters were carried. The first passenger was 85-year-old Alexander Kennedy who 53 years earlier had pioneered the route by bullock-dray, taking eight months for the trip.

By this time the Qantas fleet had grown with the addition of two Armstrong-Whitworth bi-planes each fitted with a 160 h.p. Beardmore water-cooled engine, and having accommodation for two passengers and the pilot. In the first year of regular services, Qantas carried 208 passengers.

The Qantas fleet began to grow with the addition in 1923 of a De Havilland 4 converted war-type machine and, later, two D.H.9c aircraft. The latter were considered very much the "last word," as they boasted a noise-reduced cabin (virtually a cockpit with a lid) and passengers were able to dispense with the customary cap and goggles.

THE EARLY DH50

Australia's first really successful, purely commercial aircraft was the DH50 which Qantas bought in 1924 and which gave real impetus to the acceptance of commercial aviation as something come to stay.

The DH50 had a real enclosed cabin with comfortable room for four passengers and in it the then Prime Minister, Mr S. M. Bruce, made Australian parliamentary history as the first Prime Minister to fly on an election tour.

Almost every year since then has marked some milestone in the growth of Qantas and Australian aviation history. The first ground-to-air radio experiments in 1925—since when Qantas has always kept right abreast of any developments in radio for aviation purposes. The first commercial aircraft (a DH50) to be built in Australia in 1926, and in the same year the company's first flying school opened at Longreach. Another flying school at Brisbane in 1927. The world's first flying doctor service organised by the Australian Inland Mission in 1928 and operated by Qantas for the next 21 years. In the same year Australia's first daily air service—between Brisbane and Toowoomba. In 1934 the first regular air service between Australia and England, Qantas being responsible for the Brisbane-Singapore section. In 1938 Qantas transferred its headquarters to Sydney and the first flying boat arrived in Sydney on the new Empire Route.

WARTIME ACTIVITY

Through the war years, although normal international traffic was brought to an abrupt halt, Qantas operated on a fast expanding, if unconventional, scale.

In September, 1939, the R.A.A.F. took over two of Qantas' Empire flying boats, plus aircrew, to form the nucleus of a flying boat squadron that was to play a major part in Australian defence and carried out an immense survey program throughout the islands to the north and east of Australia.

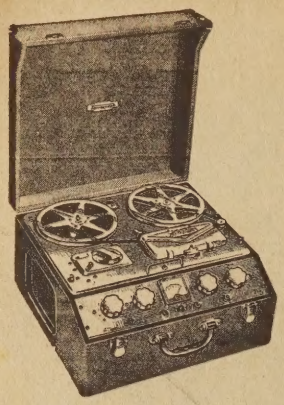
Through the war years Qantas ferried Catalina flying boats from America for the Federal Government; lost five flying boats to enemy action; took part in the famous Buna-Gona "bully-beef bomb-

QANTAS AIRLINE WAS BORN HERE

The first Qantas office in Duck Street, Longreach, is an eloquent contrast with the modern building shown on the opposite page.

The first Qantas aircraft, an Avro 504K with a Sunbeam Dyak 100 h.p. engine, was taken into service in 1921. The heavy water-cooled engine limited severely its take-off and climb.

Arrival in Winton of the first air mail on November 3, 1922. The passenger was 85-year-old Alexander Kennedy. The pilot, Hudson Fysh, now managing director.



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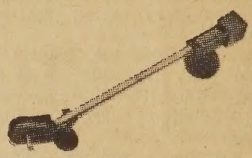

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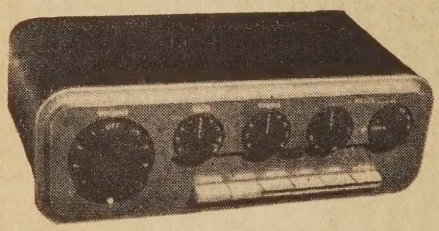

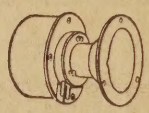

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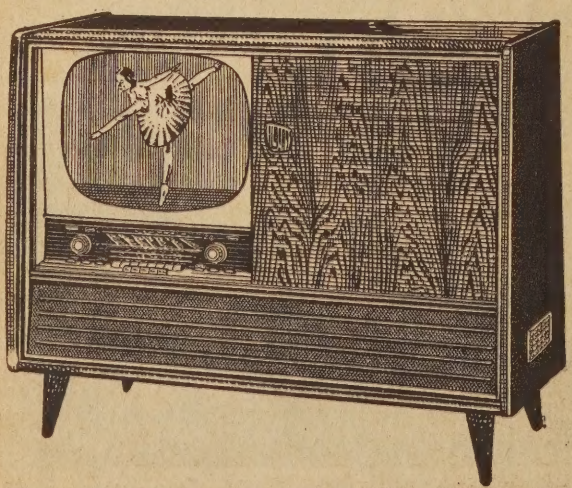
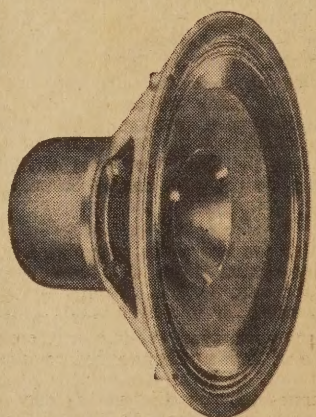


GRAETZ



Goodmans

ings"; carried 12,744 passengers in 1942 alone between Townsville and Port Moresby; during the New Guinea campaign made 765 Empire flying boats flights, carried 24,167 frontline troops and equipment into battle zones and evacuating casualties; and in July, 1943, when enemy advances cut normal England-Australia services, commenced the famous Indian Ocean flights from Perth to Colombo—3,513 miles non-stop in heavily overloaded Catalina flying boats.

ERA OF EXPANSION

Since the war, using first converted wartime bombers and then gradually acquiring postwar commercial aircraft, Qantas has had its greatest expansion. Almost every year has seen the opening of new services. A new direct service to London. Services to Japan, Noumea and Suva, Lord Howe Island, New Guinea, Hong Kong, Colombo, Bombay, Djakarta, Beirut, Frankfurt, South Africa, North America, and the world's first direct round-the-globe service.

Now with its new fleet of Boeing 707's Qantas is chalking up a new series of aviation "firsts." Australia's first jet airline. The first trans-Pacific jet service. And the first round-the-world jet service.

Introduction of the Boeing jet opens a completely new chapter of commercial aviation, for, while previous new types of aircraft have usually represented a speed increase of about 30 m.p.h. over their predecessors, the Boeing 707 represents a sudden leap forward to an aircraft twice as big and twice as fast as its predecessor; carrying twice as many passengers and getting them there in half the time.

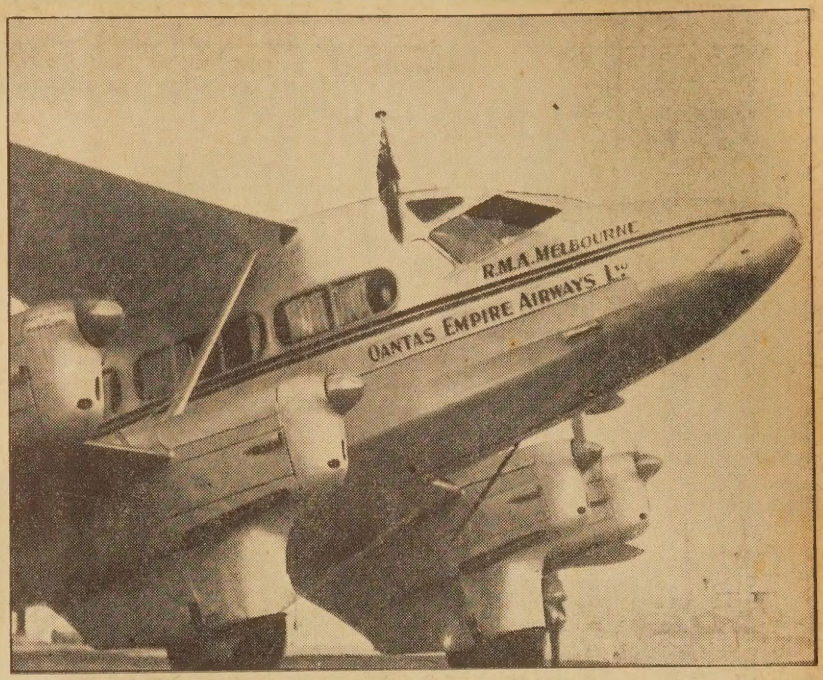
The Boeing 707 airliner is 134ft 6in long overall, with a wingspan of 130ft 10in and a tail fin rising nearly 40ft above the tarmac. Its fuselage is 12ft 4in wide and contains a passenger cabin with the floor area of a two-bedroom house.

It has a wing area of 2,433 square feet. Its gross weight at take-off is 247,000lb, and that is 1,000lb less than it weighed when it began taxiing out, because its four thirsty jet engines lap up a thousand pounds of fuel in merely taxiing and checking engines before take-off.

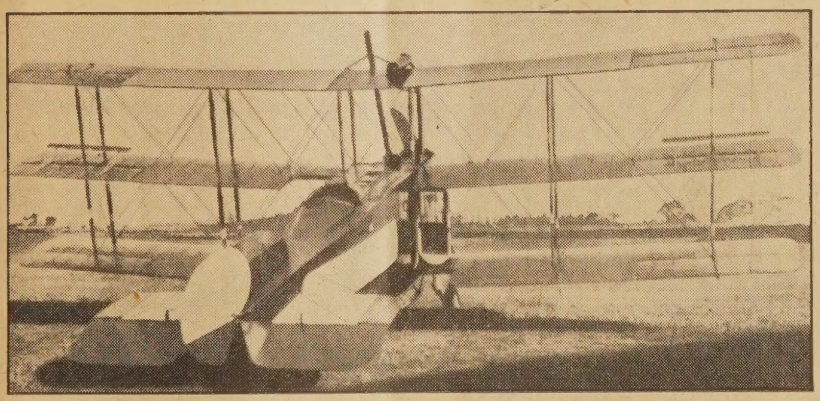
It carries 14,500 gallons—52½ tons—of fuel and more than 34,00lb of payload with room for up to 120 passengers.

The latest proud acquisition by Qantas is the Boeing 707, which will reach London in 27 hours' flying time, carrying 30 first-class and 60 tourist-class passengers.

FIRST 4-ENGINE OVERSEAS PLANE



Australia's first 4-engined aircraft, the DH86, went into service in 1934. These aircraft flew the Australia to London route and carried mails.



This Avro triplane was not a success. It was condemned as unairworthy and unsafe, cost £4,000, and saw no service. In 1921 Hudson Fysh flew it in the Aerial Derby and gained second place at an average speed of 69½ m.p.h. It carried four passengers and was later broken up for parts.

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M87A

Yet this massively dimensioned, 110-ton aircraft actually flies at the speed of a bullet from a .45 pistol.

Pushing it along at this speed are four Pratt and Whitney JT3 engines.

Production of these engines runs now into the thousands to make it the most thoroughly tried and tested jet engine in commercial use.

Each weighs only 4,284lb, yet produces enough power to lift more than six tons straight up. The 707's engines each produce more than 13,000lb of thrust at take-off; to equal the Boeing's cruising speed a conventional piston-engine airliner would require some 30 engines. Even when cruising the 707's four engines produce thrust equal to nearly 40,000 horsepower.

Apart from introducing flight speeds which shrink the tourists' world to attractive new dimensions, the Qantas 707 jet airliner sets standards of travel luxury and comfort that are as revolutionary today as was the first true cabin model DH50 when Qantas introduced it 33 years ago.

To describe travel in the 707 as "quiet" and "vibration free" is not to use these terms in the merely relative sense.

It is quiet—so quiet that you can converse in normal living-room tones with a friend several seats away. And there isn't enough vibration to raise even a ripple in your after-dinner coffee.

As well, cruising at 35,000 to 40,000 feet, the 707 flies above most bad weather and air turbulence. What it doesn't fly over it flies round, guided by radar equipment that can detect weather trouble spots 150 miles ahead.

From Qantas' first 60 m.p.h. biplane to the huge Boeing 707 is a tremendous jump, but already, the company's long-range planners are looking to the future; to aircraft that are not yet even on the drawing boards and to who-knows-what new vistas of air travel.

TRANSISTORS RUN 15lb TV SET

A 2-inch picture tube gives 80 square inches of display with the aid of a mirror attached to the top of the set. Picture at the right shows the aperture through which the rechargeable battery is made available. The set uses 21 transistors.

Recent developments in transistor manufacture allows them to be used at extremely high frequencies, as high as several hundred megacycles. This extension into the VHF region has allowed transistorized TV sets to be designed although of modest proportions.

RECENTLY announced in America is this completely transistorised TV receiver which is now available on the market.

Its picture is produced on a small TV display tube, which does not require voltages as high as those needed for full sized tubes.

The available picture is about 10in by 8in.

The receiver is made by the Philco Corporation, and weighs 15lb including the weight of the battery.

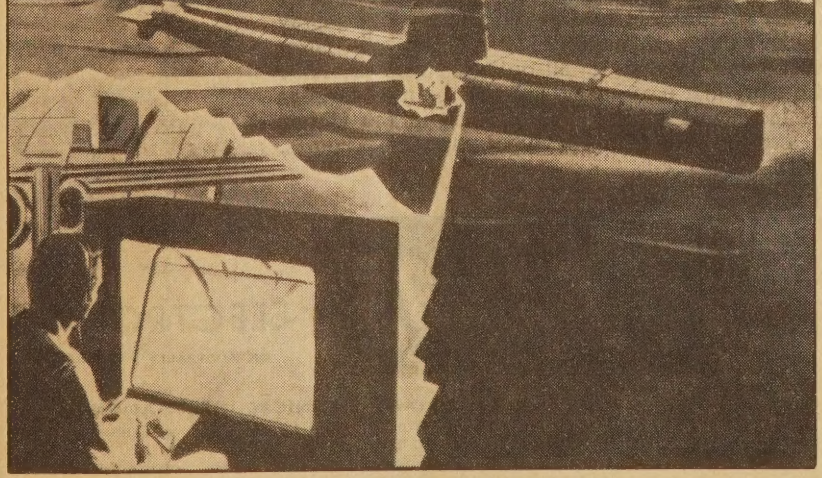
Its retail price in America is 250 dollars, or about £120 Australian.

The set uses a total of 21 transistors for both audio and video circuits combined. A 2in cathode ray tube is used to provide the picture which is optically magnified. Initial picture size is 1¼in x 1¼in. This small picture is reflected in a one-way flat mirror and projected on a parabalic mirror which magnifies it to an 80 sq. in size.

The battery used was developed jointly by Philco and Eveready. It can operate the set for five hours and is rechargeable. Total lifetime is between 80 and 100 hours, it weighs 1½lb. The receiver can be operated by battery or standard house current. An earphone outlet is also provided.

Basic chassis of the unit is made of steel. The lower part is covered with leather and the top, which contains a light hood to reduce ambient glare, is made of plastic. A telescoping rod antenna is located at the top.

Viewer controls are located at the side of the speaker to turn the set on, control contrast, volume and range. The channel selector is on the front face. An aperture at the back contains outlets for recharging the battery.

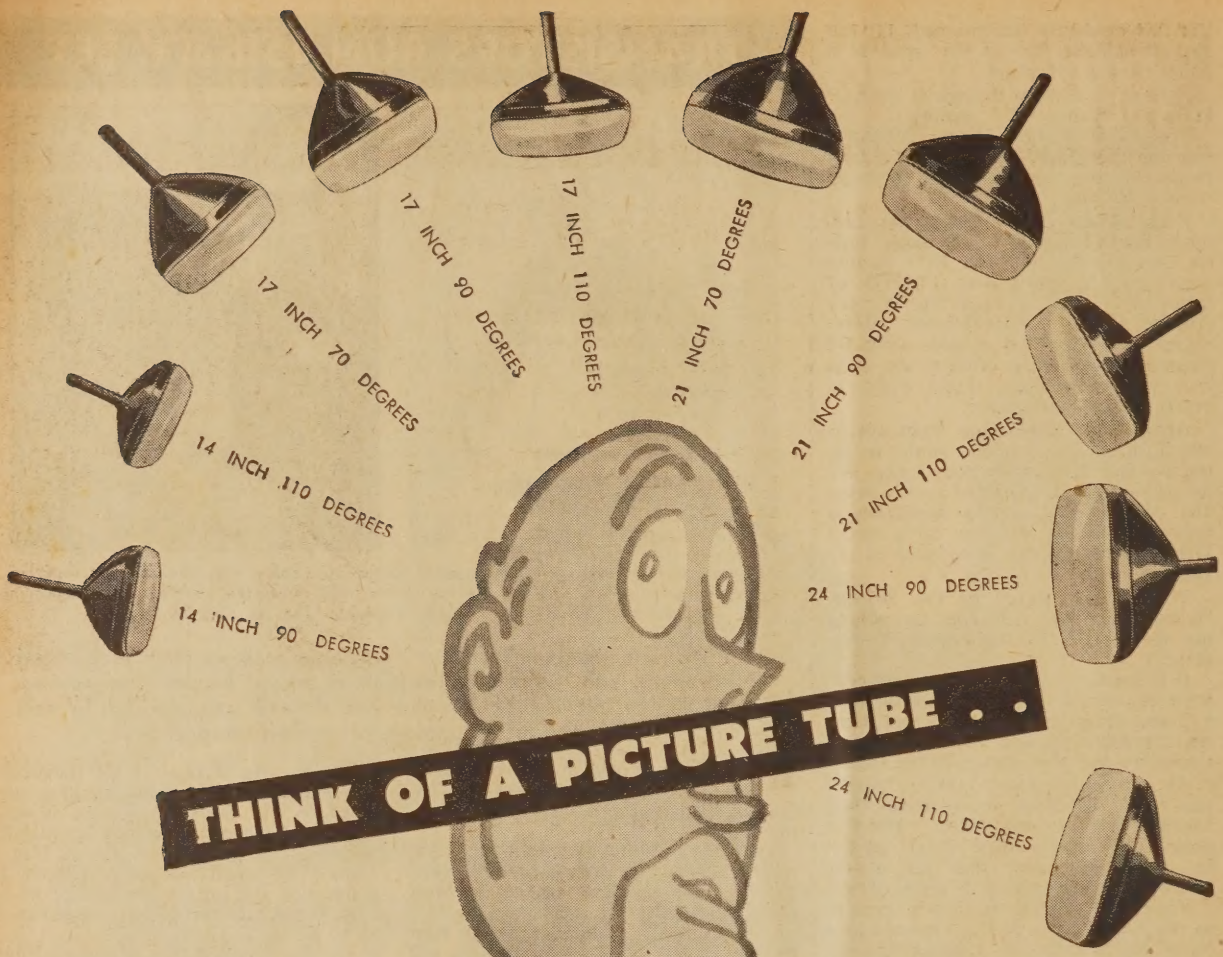


Artist's concept of a special television system which enabled the atomic submarine Skate to surface exactly at the North Pole without being damaged. A special camera mounted on the deck of the Skate, located ice lakes under the perpetual dark polar ice cap and transmitted the images to a monitor inside the submarine.

RAILWAY TELEVISION

AT a main line railway station information concerning trains has to be passed from the signal-box to several other people, such as the inquiry office staff, the station announcer, and the arrival-indicator operators.

In an effort to improve efficiency British Railways have arranged to install a Deccafax system at King's Cross terminal for a trial period. The flying spot scanner is housed in the signal-box and information is written on a prepared transparency. At the receiving units a change of information is announced by the ringing of a bell. The system uses the 405-line, 50-frame, positive modulation standard and the video signal is carried on a co-axial cable at a level of about 1.5 volts.


17 INCH 70 DEGREES
17 INCH 90 DEGREES
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TE7/FP

WHISKERS MAKE SUPER METALS

WITH SIX TIMES THE STRENGTH OF STEEL

Engineers have discovered that it is possible to make a "metal" many times stronger than the strongest steel now manufactured. Should they be able to develop the technique to produce it in usable quantities and at a favourable cost, it could revolutionise many things such as the construction of aircraft parts in which the weight factor is most important.

THE "metal" would be composed of "whiskers" suitably bonded together. The word, "whiskers," until recently meant little to the metallurgist, but today it refers to a research project of high priority.

Soon after the last war, engineers were mystified by a series of serious and baffling short circuits, which kept occurring in cables and equipment, which should have been completely safe.

In an effort to find the cause of the short circuits, they tore the offending equipments apart, and found that, jutting out from metal areas under high electron flux were tiny, wiry strands or splinters which had apparently grown out of the metal.

The assumption was that they were formed by atoms, which had boiled out of the metal and deposited themselves as "whiskers" in a regular crystalline structure, sometimes straight and sometimes in the form of a spiral.

EXCEPTIONAL STRENGTH

In handling these tiny metal strands, it became obvious that they possessed exceptional strength. In fact, the strongest of the whiskers, which have diameters of less than one ten-thousandth of an inch, can have a tensile strength of two-million pounds per square inch, as compared with a maximum of 350,000 psi for modern steels.

This means that some of these whiskers have a strength of up to six times as great as that of the best modern steel.

So far, so good. But how can anyone make use of this fantastic property, and, for that matter, what is the cause of it?

Physicists and scientists have come up with the answer that metals as we know them aren't as strong as they should or could be, and that whiskers aren't really remarkable nor do they possess any magic property.

Their crystalline structure is simply put together more efficiently.

They have calculated from the difference between electrostatic repulsion and bonding energy of metal atoms that the tensile strength of a perfect crystal theoretically should be on the order of several million pounds per square inch.

CRYSTAL STRUCTURE

The fact that they are not, has long been the subject of speculation, and no one had produced a satisfactory explanation.

The discovery of the whiskers and their very much higher strength has confirmed the theory that the relative weakness of ordinary metal is primarily due to imperfections in the crystal structure.

Research into metal whiskers is taking place in many laboratories, and the defence forces, particularly the air forces, are showing the keenest interest in the possible results.

A spokesman for the American National Aeronautics and Space Administration has said that it might be possible to make usable metal from whiskers in about five or 10 years, but the difficulties indicate that the 10-year period is more likely.

A photograph of whiskers growing on zinc.

One peculiarity of the whiskers is that they are not of equal strength. Only one in about ten has the unusually great tensile strength. And the only way to select these super whiskers is to physically try them out.

This is done by clamping them in a test instrument and pulling them apart. Those that stand the strain are the right type, and those which do not are discarded.

Naturally, this is a long and tedious business. But, when the process of selection is done, a way has still to be found of welding the whiskers together to form a useful piece of metal.

Current practice is to bond them together in a suitable material which must be ductile and able to carry a shear load.

One method suggested is similar to that used for bonding wires together. The wires, immersed in molten copper, are forced through a funnel-shaped piece of metal. After this process is complete, and the copper freezes, a material of very high strength is formed.

TEST WITH STEEL

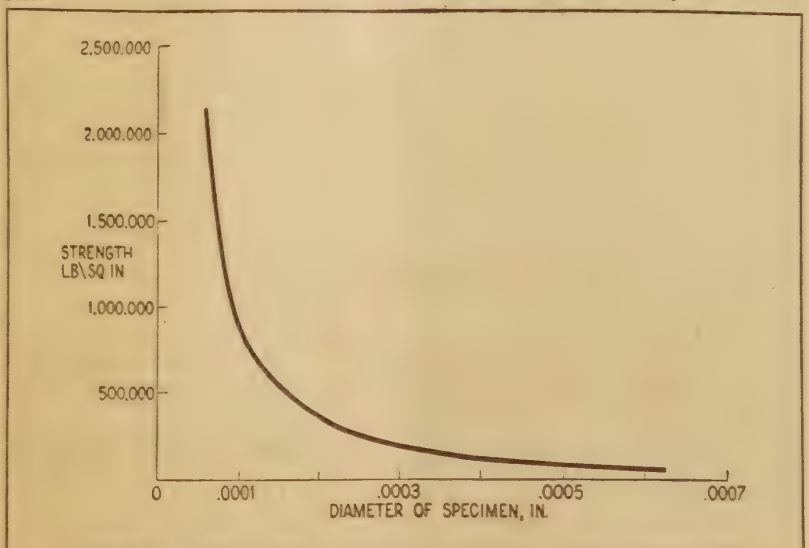
By this method, scientists have made a section using ordinary steel piano wires ‡-inch in diameter, and with a strength of 320,000 psi, more than double that of the original piano wire from which the section was made.

There seems no limit to the length of such manufactured wire, and the effect of the copper surface on the metal crystals does not appear to be as great as had been anticipated.

One of the best metals for growing whiskers appears to be tungsten, itself one of the strongest and purest of metals. It is stronger than pure iron, although not as good as steel. But there are problems in growing whiskers with just the right combination of impurities, to preserve the desirable nature of the original steel.

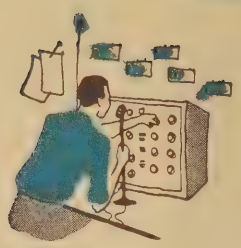
We have now the position that some

(Continued on Page 120)



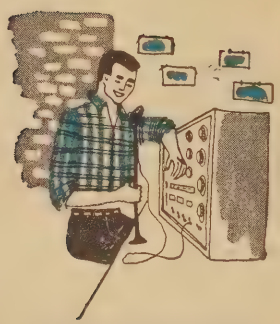
This graph shows the maximum strengths of pure iron whiskers. Tungsten curve would be even higher.

AWV

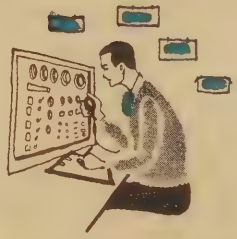


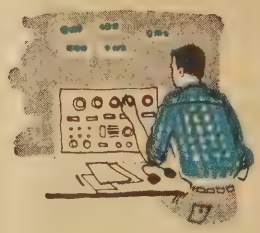
Calling All Hams...

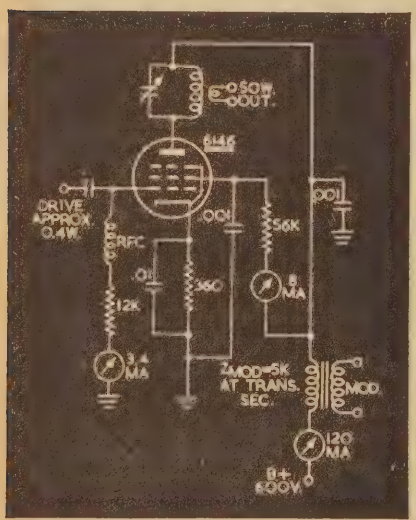
Because of its small sturdy construction, high efficiency and high power sensitivity, the Radiotron 6146 VHF Beam Power Valve is ideal for use in both mobile and fixed equipment. Similarly, its suitability for both class licences makes it the perfect valve for use in transmitters and audio amplifiers.



50 W. PLATE-MODULATED CLASS C POWER AMPLIFIER







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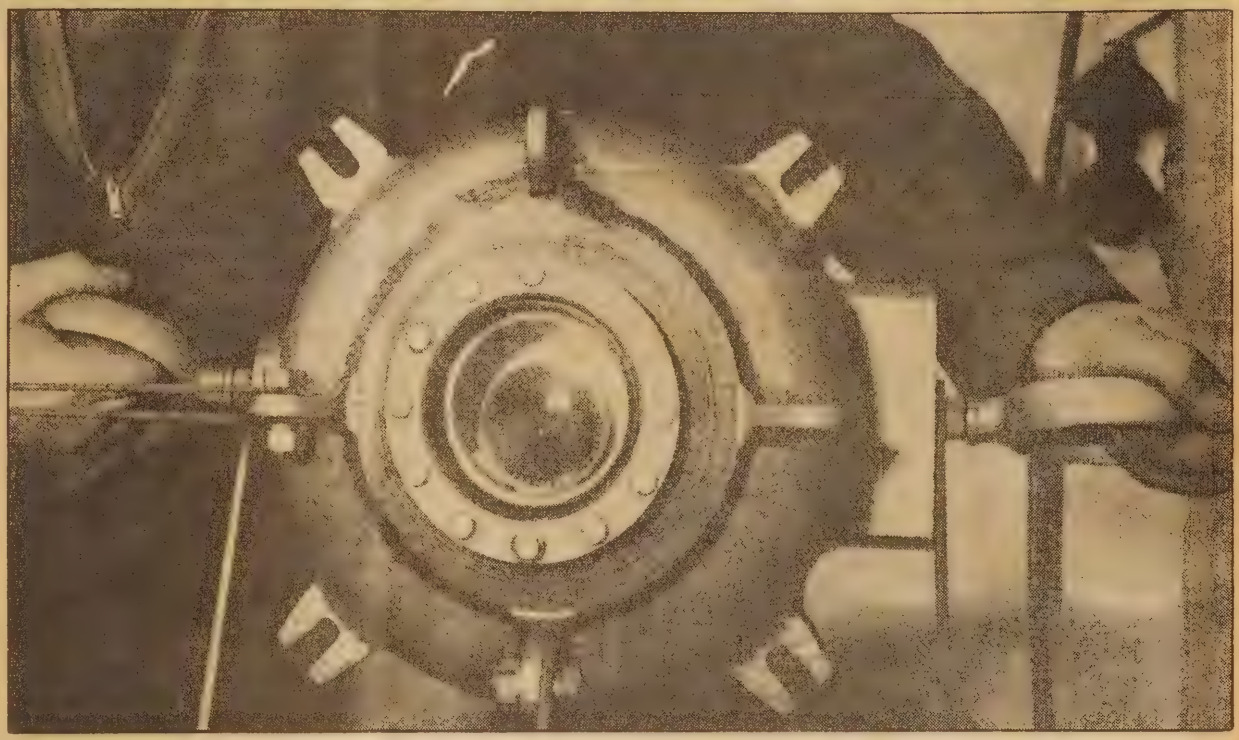
ELECTRONIC EYE PROBES OCEAN



Here is the TV camera in its case ready for use. The camera lens can be seen through the window of the water-tight casting.

COULD REVOLUTIONISE WORK UNDERWATER

Since early experimenters with underwater TV demonstrated its value, more and more uses have been found for the new technique. Both EMI and Pye in England have shown what it can do.

ILLUSTRATED here is a special camera produced by Kiel Engineers in association with Grundig. It is extremely compact and simple to use, and its makers consider that it could revolutionise all industries and research carried on under water.

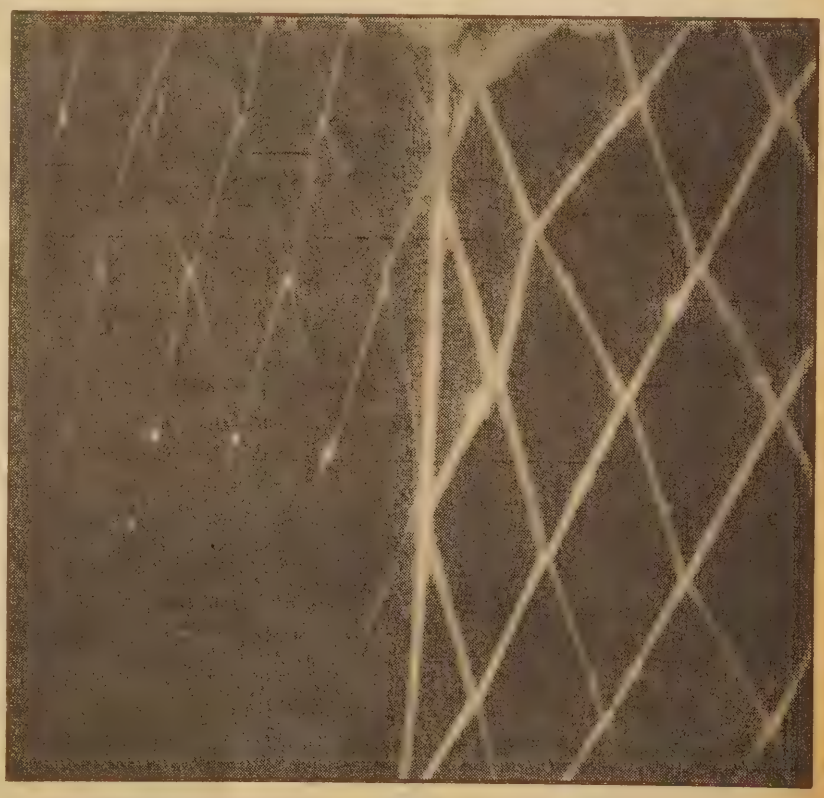
For instance, it may not be necessary to send a boat to dry dock to assess the damage after a collision as so often happens. Engineers can inspect the damage by TV and instruct divers as a result of what they see on the screen.

Salvage companies may use TV to locate exactly the position of sunken vessels.

It could also be of great value to engineers engaged in underwater construction of quaysides, dams, jetties, bridges and pillars.

Pipes, tubes, cables, etc., can be placed in position under the watchful eye of TV, which can also locate obstacles for shipping routes.

New opportunities will exist for inspection of sea life, oyster beds and other centres of cultivation.



This photograph was taken from the TV screen showing the underwater camera focused on a fishing net of part cotton and part nylon. Note that the nylon is almost invisible, whereas the cotton can be seen—particularly by fish.

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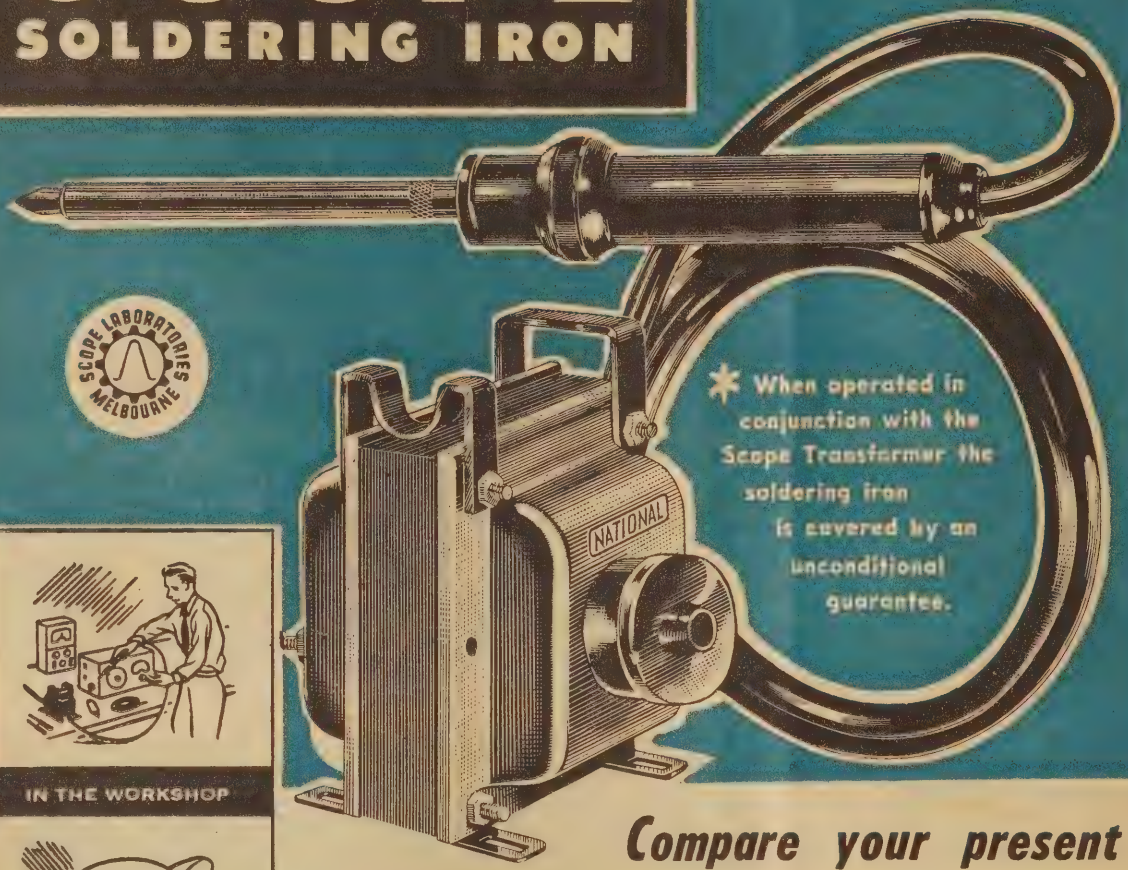

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GLOWING NUMBERS REPLACE DIALS

ELECTROLUMINESCENT PANELS ARE THE ANSWER

Glowing Electroluminescent panels may replace the maze of dials in aircraft cockpits and simplify auto dashboards, according to Westinghouse who have developed a new electronic device for displaying numbers or other kinds of information on a thin, flat, radiant screen.

ELECTROLUMINESCENCE does away with conventional lighting fixtures and provides light from a flat surface.

The new device is called an "electroluminescent digital indicator." Bright enough for use in broad daylight, it is the first instrument of its kind to be built entirely of "solid-state" elements —those which, like transistors, take the place of electronic tubes but are smaller and have no moving parts.

The indicator has been used experimentally to display the pressure readings which will exist inside the boiler of a nuclear power plant.

A digital screen has advantages over conventional methods of displaying numerical information, especially where speed and accuracy are important, it is claimed. There are no dials to watch and no markings to estimate in order to get the exact reading.

Such a screen carries only the information desired and most of the screen is active in displaying it. Only a small part of the face of a conventional meter —often less than 1 per cent—is active in telling the observer the information he wants. This is a waste of space, and the many markings and lines are confusing to the observer. He may hesitate in reading them, make errors in estimating and, as a result of such strain, may become fatigued.

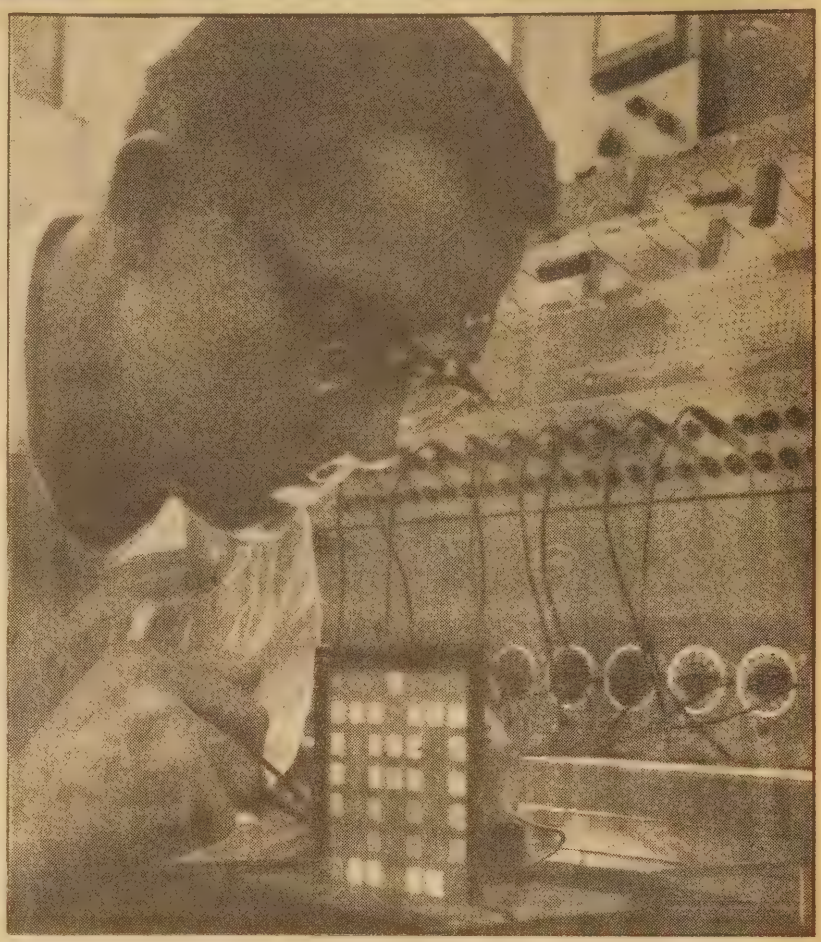
MINIMISES PROBLEM

A digital display does much to overcome these problems. Consider, for example, the pilot of a modern airliner flying at a speed of several hundred miles an hour. Data on engine performance, the plane's position, and related information must be conveyed to the pilot in the fastest, most accurate and clearest way possible. Showing this information in actual numbers does this.

Such digital indicators have in the past been too bulky, too dim, their numerals too small and unreliable, or demanding too much power. But an electroluminescent digital indicator has none of these objections.

The unit is unusually compact for a display device. The numbers are shown on a thin panel, which can be of any desired size and need be no thicker than a sheet of ordinary glass. The panels are simple, rugged, low in power consumption and inexpensive. Their brightness can be changed at will, and they can be made in a wide range of colours.

The panels are flat screens with a series of phosphor-coated electroluminescent strips which glow when they are energised electrically. Seven of the strips will form any number from zero through nine. When 21 strips are switched in and out of the circuit they will display any number from 0 through 999. Using a different design, a screen with 14 segments can display any letter from A to Z, and in addition show the numbers zero through nine. Transistors have been used as switching elements.



A series of electroluminescent numbers displayed on a screen, which may also be of different colours, is expected to provide important advantages over conventional dials and display methods where fast and clear reading is essential.

BRITISH RAINPROOFING DISCOVERY

A WIDE range of fabrics — cottons, poplins, gaberdines and even a nylon and cotton mixture—is now being treated with a new rainproofing material. The substance that repels the water is not a silicone but a fluorochemical. The degree of rainproofing it confers on fabrics is said to be higher than any previously achieved and this report has been confirmed by tests at the Better Fabrics Testing Bureau in New York.

Similar tests had already been made at the Laboratory of the Retail Trading-Standards Association at Henley and these showed that, after the equivalent of three inches of rain, the penetration was nil. Other tests after one to six dry-cleanings and pressings gave equally satisfactory results. The proofing material is the outcome of three years' work by British chemists. Sales of fabrics proofed with it are reported to be heavy, those by Aquascutum to the United States having doubled.

In the course of development, the researchers met difficulties not only with different materials but with different colours in the same material, the chemical reacting on some of the dyes. In the end a formula was found that would yield the full proofing effect over the normal range of raincoat fabrics.

Some of the ear-marks of the druggist of earlier times, the large ornamented jars, the cast iron pots, the huge ungainly scales. Today's equipment gleams with stainless steel and has almost unlimited variety and accuracy.

The Apothecary Has An Ancient History

To the average man the apothecary is still a mysterious person, dealing in strange mixtures and formulas. But his work has little in common with that of the ancient chemists and alchemists who searched for the philosopher's stone, postulated preposterous theories about the universe, and tried to turn base metals into gold. Yet from the inquiring minds of the past grew our highly specialised knowledge of the physical sciences.

by Calvin Walters

THERE is far more behind the dispensing of medicines in a pharmaceutical dispensary than is generally realised by those who avail themselves of its facilities.

A widely accepted view is that most of the medicines are nothing more than water coloured with some harmless dye and flavoured with something to disguise the fact that you pay through the nose for a bottle of practically nothing at all.

The strange part about all this is the fact that the very people who believe in this sort of nonsense continue to patronise the chemist who they believe is "taking them down."

The fact is that no such hanky panky goes on today. We are far more advanced than we were during the days of the old apothecary.

In those days many weird things were practised because everything was a matter of hit or miss and if the patient died then it was just too bad. It could even have been the medicine which hastened the demise, but nobody cared much.

When primitive man got wounded by a belt behind the ear with a club or by a stone axe embedded between his shoulder blades, he no doubt found that bathing it with water helped to relieve the pain. He may also have discovered that mashed up leaves of some kinds of plants assisted the healing process.

The history of medicine and the uses of plants or herbs for the purposes of healing the sick goes far back into antiquity and it is interesting to trace this history in order to follow the progress which has been made in the art of dispensing medicines.

Research points to the East as the birthplace of the art of healing. Asia Minor, North-West India and Egypt are the localities recognised as being skilled in the uses of herbs and plants.

It was the wise men and women of the various tribes who managed to acquire the knowledge of the uses of herbs to heal the sick. This knowledge was acquired by word of mouth handed down from generation to generation.

DISEASE AND DEMONS

Human nature being what it is, it was inevitable that the unscrupulous "learned one" would batten on his fellow tribesman's afflictions.

Thus it was that the art of the healer became associated with that of priestcraft. These priests pretty soon hit upon a great idea. This was to assert that disease was caused by some ill-disposed demon getting into a person's body. It was therefore logical to assume that the best treatment was to resort to the use of something which would be obnoxious to the demon.

Thus we learn that certain drugs obtained from plants contained portions of the souls of the gods who were kindly to man.

All one needed, therefore, to gain the power of life or death over one's neighbour, was a knowledge of the appropriate drug to use.

For certain diseases the priests really did have a knowledge of certain drugs which exerted a beneficial effect. Naturally, the knowledge of how to prepare them was a close secret and the priest was able to practise his craft very craftily indeed.

The art of the apothecary thus originated in these ancient times in the methods used for preparing the substances used for the treatment of disease, just as today the art of pharmacy is the science of compounding and dispensing medicinal substances.

While in early times the physician and apothecary were vested in the one person, some 1800 years B.C. began to see the two arts being separated so that the physician diagnosed the disease and prescribed the appropriate remedy, while the apothecary compounded the prescription as ordered by the physician.

Even in those times the same aspersions were cast against the apothecary

as are cast against our present-day pharmacists, as mentioned earlier. This is recorded by Pliny, who didn't seem to think much of the dealers in the art of healing. He said of them that many physicians didn't know the names of the drugs they used, while "the apothecaries adulterated their medicines, sold old plasters and drugs spoiled by age."

So far advanced were the Egyptians that some of their writings of the year 1500 B.C. contain references to over 700 substances which one way or another were used for treating the sick. Not only were still well-known drugs such as aloes, castor oil, juniper, opium and so on used, but the Egyptians seemed to have got on to the minerals such as antimony, as well as turpentine, sodium carbonate, squill, peppermint and lots more.

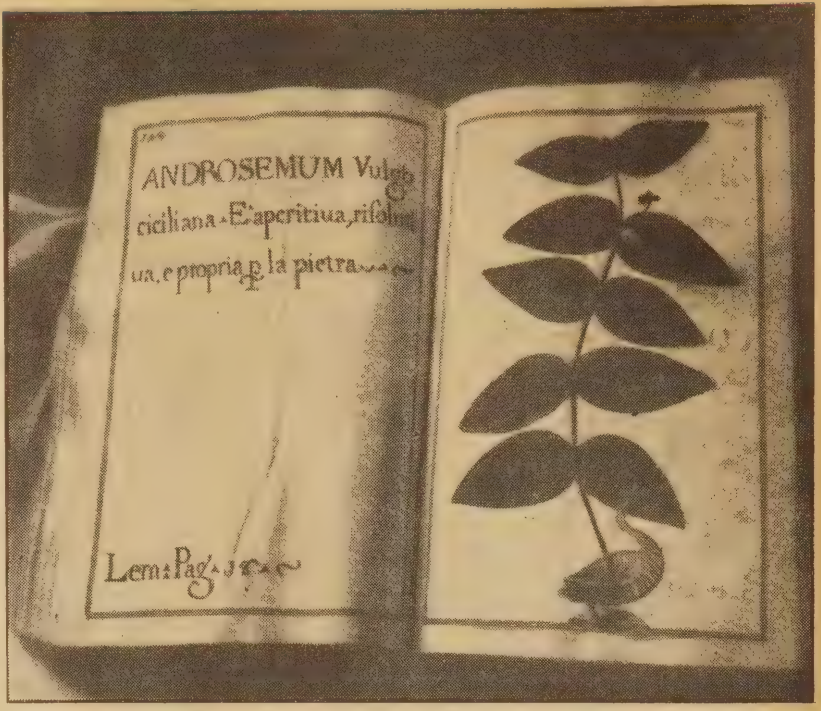
OLD PRESCRIPTIONS

These medicaments were put up in much the same way as today. They used pills, decoctions, confections, draughts, lozenges, inhalations, infusions, powders, plasters, poultices, ointments, embrocations, lotions and fumigations.

Many of the prescriptions given in the Egyptian writings are in a form very similar to those used at the present time, and there is no doubt that many present-day prescriptions would be handed down from antiquity, having been proved effective for their particular purposes.

There is no record of how the ancient people found out about the efficacy of the drugs they used. In those days the art of controlled experiment was not known. No doubt most of the results were achieved by trial and error, possibly using slaves or unwanted concubines as the guinea pigs. If the subject recovered the mixture was not poisonous and vice versa.

Many references to the Apothecary were made in writings of the Bible. We come across such statements as the following from Exodus chapter 30 and 35 verse, "Take thou also . . . principal spices of pure myrrh . . . and of sweet cinnamon half as much . . . and of sweet calamus . . . and of cassia five hundred shekels after the shekel of the sanctuary, and of olive oil an hin: and thou shalt make it an oil of holy ointment, an ointment compound after the art of the apothecary; and it shall be an anointing oil."



Brother Basilio, "greatest of the pharmacists," kept his prescriptions in beautifully illuminated books. On facing parchment pages he would place a prescription and a specimen of whatever the ingredients derived from leaves of plants, roots, flowers etc.

As late as the seventeenth century there was a popular theory that all metals and minerals were the result of reaction between sulphur and mercury, with fire as the necessary agent to the process. This old picture shows the two materials at work under the ground. Belief in such processes upheld the idea that gold could be made by a fusion of baser metals.

Then we find the following in Ecclesiastes 10 and 1:—"dead flies cause the ointment of the apothecary to send forth a stinking vapour."

They apparently knew a lot about mixing medicines but knew not the spray which maketh of the fly dead meat.

Now we come to the inevitable ancient Chinese. What would history be without him?

It would appear that as far back as 2000 years B.C. the Chinese knew about drugs and minerals. One chappie named Chen-Hung wrote a book on medicine containing 260 prescriptions. He lived about 2737 to 2697 B.C. and the fact that he tried all the herbs and drugs on himself possibly accounts for his short life.

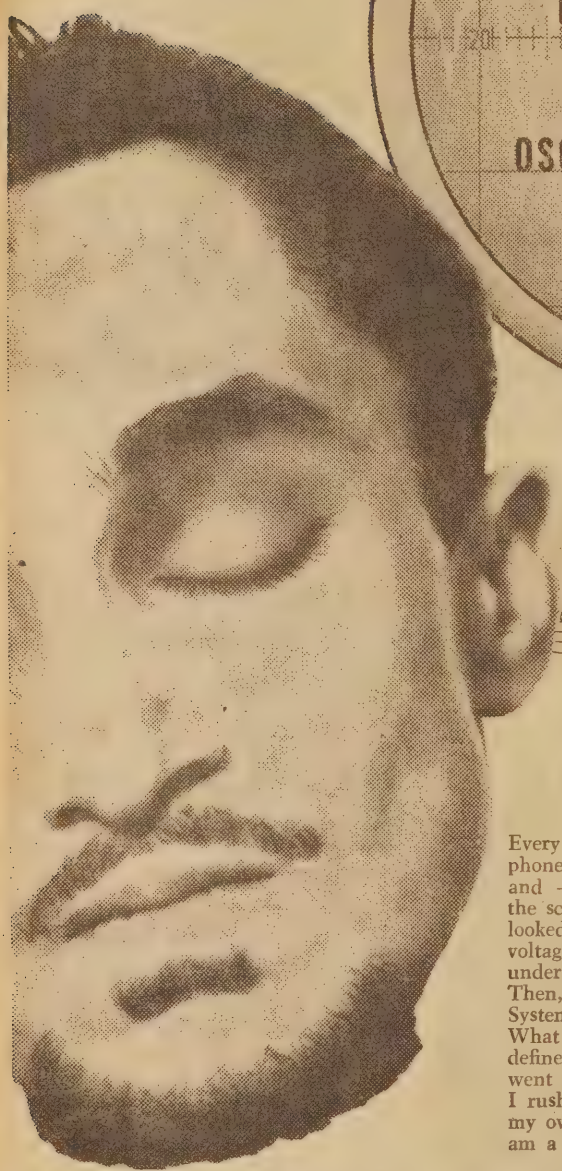
CHINESE MEDICINE

Then there was the Emperor Huang-ti who made a collection of all the works on medicine he could find and bound them into one encyclopaedia.

There is another work by a fellow with the forbidding name of Lischitschin who flourished about 900 B.C. This work is called the Pen-tsao. I am assured that it had nothing to do with Sao biscuits as they didn't exist at that time. This work contained nearly 12,000 recipes.

An interesting fact about Chinese medicine was their method of classification of various diseases. These they signified as hot or cold. For hot diseases they collected "heating drugs" in the summer and made them up by boiling or heating. The cold drugs were collected at night during the winter and infused in cold water.

The study of drugs was carried out throughout the Roman period, and well into the Christian era the apothecary appeared in England. He is first mentioned about A.D. 1180.



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Then, at the house of a musician friend, I heard a Philips Hi-Fi System. I was suddenly carried away by the sheer joy of listening! What a lovely sound! Clean tight bass; creamy smooth highs; crisply defined middles . . . the strings went la-lah-de-dah; the kettledrums went dum-dedum . . . it was music!

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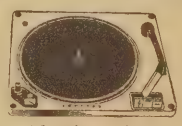

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In England the apothecary became associated with kings and noblemen. They formed themselves into all sorts of guilds and thus became organised.

One guild was a combination of Pepperers. Spicers and Apothecaries but, as always, dissension arose in 1423. The pepperers, spicers and apothecaries in turn accused each other of adulterating their goods. The Rector of the Grocers Company was then given the power to search shops for adulterated goods. If an offender was found he was hauled before the Mayor and his goods thrown into the street.

As this did not stop the practice, Henry VI created the office of Official Garbler

Now one understands garbling as mixing things up, but the Official Garbler did just the opposite. He unmixed them. His job was to clean, separate and examine all drugs in order to detect adulteration.

DRUG CONTROL

The first fellow to suffer the penalty was a cove named John Ashfield, who was fined for "makynge of untrewe powder of gynger, cynamon and sawnders."

Coming down to 1599 we find James VI of Scotland becoming concerned about the sale of drugs by unqualified persons.

He issued an edict as follows: "Na manir of personis sell onie droggis within the city of Glasgow, except the same be sichit be the said is visitouris, and be William Spang, apothecar, under the pane of confiscatoune of the droggis."

As time went on more laws were framed to control the apothecaries, and in 1617 King James I granted the apothecaries their Charter of Incorporation. The first official Pharmacopoeia was printed in 1618, and an official proclamation was issued on April 26, 1618. making it compulsory for "all apothecaries in the realm to obey this Pharmacopoeia and this only."

From that time on new editions of the Pharmacopoeia were issued and have continued to the present time.

Strangely enough, although great progress was made in the use and discovery of drugs during the fifteenth, sixteenth, and seventeenth centuries, a lot of superstition abounded.

This was particularly so in regard to the belief that parts of the human body or any other creature for that matter were endowed with health-giving properties.

THE SKULL WAS POPULAR

Pieces of human skull digested in spirit was a favourite. The most popular skulls were those from Ireland, where the bodies of criminals were allowed to hang from the gallows until they fell to pieces. These skulls were nice and white and sometimes also grew a fine moss, which added to the virtues of the skull. Brains were a popular commodity. One recipe was as follows:—

"Take the brain of a young man under 24 that died violently. . . Beat it and add cephalick waters as of Tile flowers, Peony, Betony with black cherries, lavender, lily. . . . Distil and make a salt from the residue. . . . Mix it with spirit . . . give from one to four scruples for a dose." You could take it if you had no scruples. At least they tried to flavour it.

AN ANCIENT ALCHEMIST AT WORK

Many amusing pictures exist showing the alchemist as a poverty-stricken and often unscrupulous fellow, but this one, painted in 1648 by the Frenchman Tiers, indicates that he could be a man of some substance with quite elaborate facilities.

They distilled liquor from human hair, "as a stimulant for a bald head." They used nail parings from fingers and toes soaked in wine for an emetic. It should have worked well. Even to think of it would act as a good emetic.

They powdered up human hearts and kidneys. It is notable that most of the recipes provided for macerating all these things in wine or ale. No doubt this would encourage some people.

MODERN LAWS

Gradually the chemists and druggists took over the sale and dispensing of drugs and the apothecary began to develop into a physician. Things were not too happy until various laws defined the various functions. Toward the end of the nineteenth century things were somewhat stabilised and considerable progress to the present time has brought the Pharmaceutical Chemist into the sphere of a true scientist.

The science of Pharmacy embraces various phases of other sciences such as Chemistry, which has to do with chemical reactions; Physics, which deals with the property of matter; Zoology, which investigates the structure and physiology of all animals; Botany, dealing with the structure of plants; Mineralogy treats the properties of mineral substances; Biology, the science of living organisms; Physiology, dealing with the functions of the parts of living organisms; Bacteriology, dealing with microorganisms; Pharmacology, or the science of drugs and their action on the body; Materia Medica, dealing with the origin, composition and properties of medicinal agents.

Pharmacodynamics or the action of drugs on undiseased living organisms, Therapeutics or the action of drugs on diseased living organisms, Toxicology or the scientific study of poisons, Posology the study of drug doses and Pharmacognosy or the study of the source of crude drugs.

Thus the Pharmacist is a man of many parts. He must make an intensive study of his profession and pass strict examinations before being allowed to practise where he has the life or death of an individual in his hands.

He must not make mistakes himself and he must be ever on the alert to detect mistakes which may appear in prescriptions given by the doctor.

Fortunately such mistakes are rare and, due to the co-ordination of the various activities of the physician and chemist and his assistants very few mistakes pass undetected.

When you go along to the doctor for a check-up, or because you suffer from some defined symptom the doctor after making his diagnosis writes a prescription.

PRESCRIPTIONS

This prescription is an order to the pharmacist to compound or supply some medicament which should alleviate the patient's distress.

When the doctor writes the prescription he does not do so haphazardly. He studies the patient's characteristics, his weight and age.

He must decide whether the patient is sensitive to certain drugs, whether some other chronic condition will be adversely affected by certain drugs he proposes to prescribe.

The doctor then in the light of his analysis determines the quantity of each drug necessary in the total prescription which when taken together in the dose

(Continued on Page 121)

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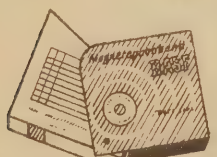

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Never loses the lid.

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U811

Technical Review

Column Loudspeakers for Public Address Systems

Using the slot-radiator principle, column loudspeakers have narrow angle coverage in the vertical plane to produce the best sound distribution in large areas where intelligibility may be masked by reverberation.

INTELLIGIBILITY of speech or enjoyment of music in many halls and public places is often lowered by the masking effect of background noise and blurring from excessive reverberation and discrete echoes which often characterise large audience enclosures. In halls where listeners are confined to particular areas, column loudspeakers have been used with great effect due to their directional properties.

To obtain the most effective sound distribution with minimum amplifier power and the greatest margin over acoustic feedback, loudspeakers should have a preferred type of directional response. This response should be restricted to an angle of plus or minus 15 to 20 degrees on each side of the loudspeaker axis in the vertical plane, and substantially unidirectional within an angle of plus or minus 60 degrees in the horizontal plane.

Loudspeaker enclosures that approximate the ideal radiating system with constant directivity over the important parts of the audio range have been designed using acoustic phase shift at one side of the enclosure. This phase shift is introduced by an acoustic network at the rear of the enclosure resulting in a unidirectional or cordioid polar response similar to the phase shift of unidirectional microphones. The acoustic phase shift method forms the basis of a column loudspeaker enclosure design which produces a response much more directional in the vertical plane than in the horizontal plane.

A practical column speaker system consists of a vertical row of horns or direct-radiating loudspeaker units. The finite width of the radiating surfaces causes the high-frequency polar response to become directional in the horizontal plane. This defect can be largely overcome by the use of horns which are narrow in the horizontal direction and by the use of the slot radiator principle.

A narrow vertical slot is used instead of the full circular opening in front of the loudspeaker cone, thus maintaining a broad polar response in the horizontal plane because of the small width of the virtual sound source.

RESTRICTED OPENING

Restriction of the sound opening must be made with care to avoid any deterioration in the loudspeaker frequency or transient response. This can occur because the slot acting in conjunction with the enclosed air cavity between it and the loud-speaker cone constitutes a Helmholtz resonator whose general properties and damping must be carefully investigated.

Satisfactory results can be obtained if the slot proportions are carefully chosen and the enclosed air volume minimised by the use of loudspeakers with shallow angles or elliptical cones mounted with their major axes vertical.

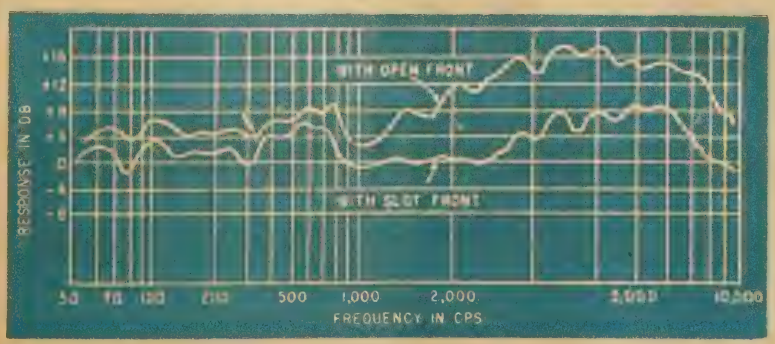
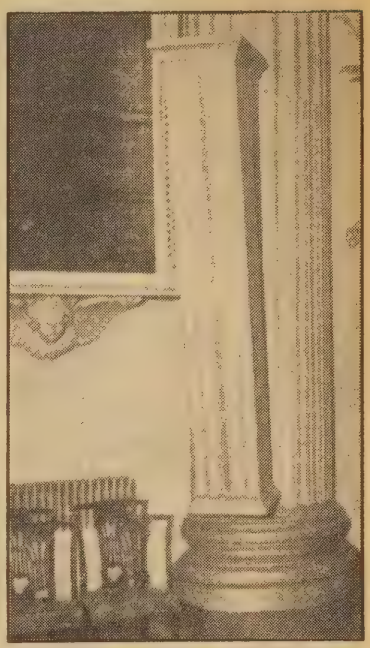


FIG. 1—Frequency response of a moving coil 10-in. cone loudspeaker with conventional open front and with 1½-in. wide slotted front.



Column loudspeaker designed to blend into design of surrounding area.

Figure 1 shows some axial response curves of a loudspeaker unit with and without a slotted front. The slot generally modifies the frequency response curve by causing a slight loss up to 1 Kc and a larger loss over the region from 1.5 to 7 Kc, flattening that portion of the curve.

The construction of a typical slotted-column loudspeaker is shown in Fig. 2. Elliptical shallow-angle cone moving-coil loudspeaker units are mounted as closely as possible one above the other behind a series of vertical slots in the 5ft high cabinet.

The slots are approximately 1½in wide in the horizontal dimension. The rear of the cabinet is vented to the outside by a slab of porous acoustic material. This material is acoustically coupled to the loudspeaker units through the air volume within the cabinet. Such an arrangement transmits a sound wave with a phase shift due to the acoustic elements represented by the back coupling volume and an equivalent series acoustic resistance mainly encountered in the porous acoustic material.

Additional phase shift occurs as the wave travels through the porous acoustic material because of the constrictions and voids encountered.

ANOTHER PROUD FIRST FROM **GOLDRING**

NEW SENSATIONAL Goldring "700"

Stereo version of the amazingly successful GOLDRING "600"

MAGNETIC VARIABLE RELUCTANCE STEREO CARTRIDGE

Now with the new "700," Goldring gives you the nearest approach to perfection in Stereophonic reproduction quality.

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Precision manufactured, simple to handle, the Goldring "700" represents a highly complex and successful solution to a multiplicity of physical, electrical and electro-magnetic problems . . . brings you an exciting difference in stereo musical enjoyment with faithful "3-D" reproduction from all forms of stereo recordings.

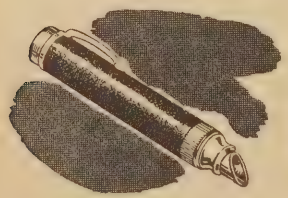
GOLDRING "700" with Diamond Styli £18/10/-

Technical Specifications

Type	Magnetic variable reductance
Stylus	0.0005in — Radius diamond (replaceable)
Playing weight	3 to 4 grams
Lateral compliance	4 x 10 —6cms/dyne
Vertical compliance	4 x 10 —6cms/dyne
Effective stylus tip mass	8 mgms
Nominal output	.3 mv @ 1 cms/sec RMS per channel
Load resistance	50k per channel
Frequency response	40 c/s — 12,000 c/s
Signal/Cross talk ratio	15 db nominal
D.C. Resistance (per channel)	1,500
Inductance (per channel)	0.5H
Max. shunt capacity	125 pf (20 kc/s resonance)

Fits all modern transcription arms wired for stereo, including the Goldring G60 Transcription Arm.

PROTECT YOUR VALUABLE RECORDS AND STYLI WITH NEW GOLDRING "RECORD CARE ACCESSORIES".



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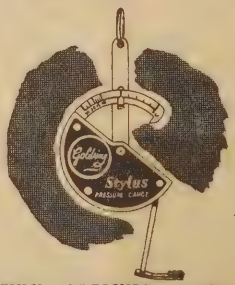

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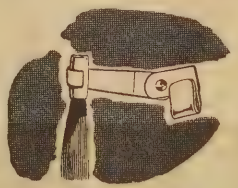

RECORD DUSTER BRUSH

Sturdy and attractively made with genuine bristle brush. Clips conveniently on the front of all type pickup arms. Removes harmful dust from record grooves directly in front of the pickup whilst in motion 2/6

See the new Goldring "700" Stereo Cartridge and Goldring "Record Care Accessories" at all leading Radio Houses. Technical Inquiries to the Sole Australian Distributors.

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ENGINEERING (AUST.) PTY. LTD.
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This is analogous to a low-pass LRC ladder network. If the constants are chosen correctly, the wave appearing at the back of the loudspeaker cabinet will have a phase shift proportional to frequency and of identical magnitude to that of the wave from the front of the cabinet in the course of propagation around the bulk of the cabinet. The net effect is to produce a cancellation of the sound pressure at the rear of the cabinet, thus suppressing rearward radiations.

This effect operates over the low frequency range up to approximately 200 cps. Above this frequency, sound diffraction effects around the cabinet bulk begin to confine the frontal radiation to the front spatial hemisphere. Rear radiation through the porous acoustic material is progressively cut off due to the low-pass filter effect of the phase-shifting network. Figure 3 shows an approximate electrical network equivalent for the loudspeaker system.

POLAR CURVES

Figure 4 shows the vertical and horizontal polar curves for a typical column loudspeaker. A fair approximation of the desired slab-shaped solid angle radiation pattern has been achieved.

It is not possible to totally suppress side lobes and rearward radiation completely, but radiation in these unwanted directions is sufficiently low as to be impossible to detect in practical use.

—By M. L. Gayford, S.T.C. Limited, London. From Electronics.

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BROADCAST STEREO

STEREO broadcasting continues to challenge the electronics industry's inventors—and two new experimental methods have now been added to those already proposed.

It is reported from the U.S. that Motorola Inc. and station WGN-TV, Chicago, joinly presented a demonstration of a proposed stereophonic TV system, using present TV standards, but adding a multiplex sound sub-carrier. The compatible Stereo-mono system has a matrixing stage to direct sounds to the proper audio amplification channels. The sub-carrier bandwidth is 5 kilocycles.

Calbest Electronics Co., Los Angeles, announced the development of a compatible stereo FM system, which uses a "narrow band" multiplex subcarrier, making possible two subcarriers, in addition to the main carrier, on a single FM channel. The Calbest technique employs a sum and difference method, with a crossover at 3,500 cycles, the output of both channels being identical above this point.

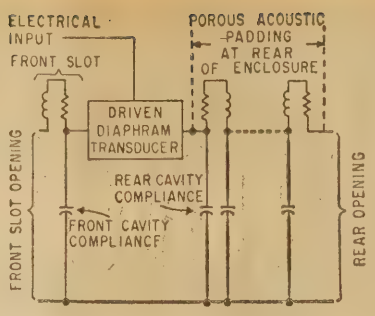


FIG. 3—Approximate electrical anology circuit representing phase shift elements of a slotted column loudspeaker at low frequencies

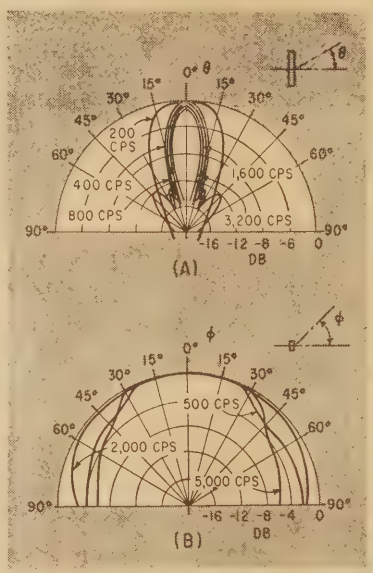


FIG. 4—Polar responses of a typical column loudspeaker in the vertical plane (A), and in the horizontal plane (B)

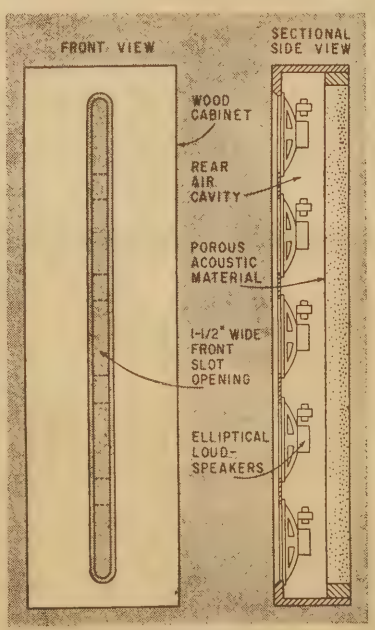


FIG. 2—A typical slotted column loudspeaker showing construction details

NEW USE FOR DRY RECTIFIERS

Switching and controlling industrial power quickly, smoothly, and efficiently presents a number of special problems, and distribution engineers are always on the lookout for new means of accomplishing this. The latest advances in "solid state" rectifiers promise some interesting possibilities.

SOLID state ("dry" or metallic) rectifiers are the latest addition to the list of rectifiers capable of being controlled by an auxiliary circuit. Previous examples have been the Ignitron and Thyratron (grid controlled rectifiers), which, with the saturable reactor and magnetic amplifier, have provided a ready means of fast and accurate control of 50 cps power.

All such devices are off during part of the AC cycle, turn the power on to the load during the half cycle, and turn it off when the polarity changes so current flows in one direction. Each output waveform shows a vertical rise when fired. "On" time is controlled by the selection of the firing point in the half cycle.

Two such "switches" connected back to back provide full-wave AC. In a bridge or centre tapped transformer circuit they supply full-wave pulsating DC across the load. The DC can be filtered by conventional means to any desired smoothness.

The controlled rectifier's forward firing point is determined by a DC control signal in the gate. Without a signal it will not fire and represents an open circuit. When the gate current exceeds a minimum the rectifier fires and conducts for the balance of that half cycle. Power is controlled by varying the triggering point during the half cycle.

Controlled rectifiers and thyratrons use an auxiliary device to generate the firing pulse. Thyratrons, in turn, can be used to fire ignitrons. Firing point of magnetic amplifiers and saturable reactors is set by the amount of current through the control winding.

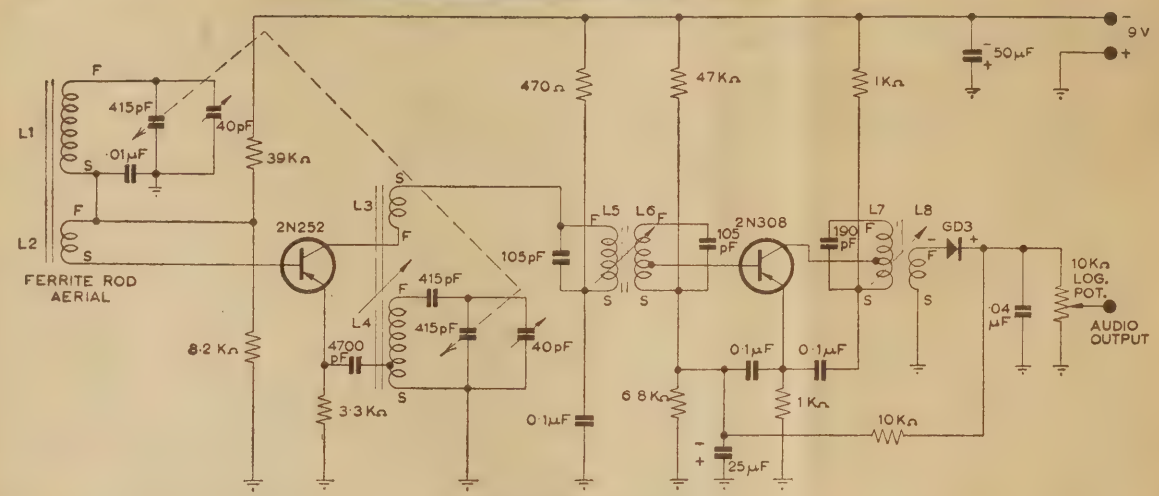
Control signals can be AC or DC voltages or currents, AC and DC combined, or multiple inputs of AC, DC or AC and DC combined. Magnetic amplifiers will accept all these. Saturable reactors accept all but AC, unless AC is rectified.

Controlled rectifiers and thyratrons need a precisely timed trigger or phase-shifting device. Magnetic amplifiers are well suited for this triggering, since they suply a steep vertical wave front. The amplifier can pass on, sum up, or average one or more inputs from transducers, synchros, and other devices.

A magnetic amplifier between the anode and the gate of a controlled rectifier prevents gate current or voltage from exceeding safe values. All that is needed is a coil in series with a rectifier. Another compact arrangement uses an isolating transformer and a limiting device, providing faster response.

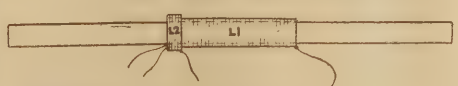
(Continued on Page 120)

STC SETS THE STANDARD FOR TRANSISTORS



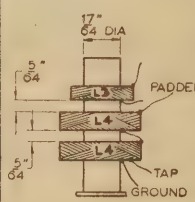
Australian-made S.T.C. transistors have proved their value in a vast number of applications. As the use of transistors grows, S.T.C., backed by world-wide research, is adding more new types to its already wide range. First to make transistors in Australia, S.T.C. keeps its lead in quality, reliability and performance.

FERRITE AERIAL COIL



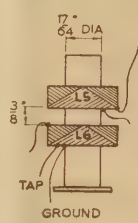
ROD: Standard Ferrite ⅜" dia., 8" long.
PRIMARY L1: 45 turns 7/41 B. & S. Litz wire.
SECONDARY L2: 5 turns 33 B. & S. double nylon-covered wire, wound over grounded end of primary.
TUNING CAPACITANCE: 40-450 pF.

OSCILLATOR COIL



TUNING SLUG: 6 mm. dia. x ½" long.
CAN ASSY.: 1⅛" x ¾" x ¾".
9/16" i.d. x ¾" o.d. ring.
PRIMARY L3: 28 turns 33 B. & S. double nylon-covered wire.
SECONDARY L4: 2 pies in series, each 57 turns 8/41 B. & S. Litz wire tapped at 5 turns from grounded end.
UNLOADED Q: 85 at 975 kC/s.
INDUCTANCE: 120 µH.
TUNING CAPACITANCE: 40-450 pF.

1st I.F. TRANSFORMER



TUNING SLUG: 6 mm. dia. x ½" long.
CAN ASSY.: 1⅛" x ¾" x ¾".
9/16" i.d. x ¾" o.d. ring.
PRIMARY L5 } Each 285 turns 3/41 B. & S. Litz.
SECONDARY L6 } Unloaded Q: 95. L: 1,150 µH.
SECONDARY L6: Tapped at 38 turns from grounded end.
TUNING CAPACITANCE: 105 pF.

2nd I.F. TRANSFORMER

TUNING SLUG: 6 mm. dia. x ½" long.
CAN ASSY.: 1⅛" x ¾" x ¾".
9/16" i.d. x ¾" o.d. ring.
PRIMARY L7: 2 pies in series 8/41 B. & S. Litz wire, each 130 turns, tapped at junction.
UNLOADED Q: 105.
L: 630 µH.
SECONDARY L8: 35 turns 33 B. & S. double nylon-covered wire.
TUNING CAPACITANCE: 190 pF.

RADIO TUNER UNIT

Shown above is the circuit diagram of a transistorised superheterodyne radio tuner unit which has been designed to cover the broadcast band. It may be combined with various transistor audio amplifier circuits to form a complete portable radio receiver.

Although the design is simple and uses few components, it is capable of good sensitivity and selectivity. The bias for each stage is obtained in a way which gives good temperature stability, and care has been taken to ensure that the transistors are being operated correctly.

Coil design data is given above and represents a good compromise between gain and selectivity.

PERFORMANCE

Frequency Range	530 to 1,620 kC/s
Sensitivity	Field strength of 300 µV/m gives 2 mV. output in 1,000 ohms
Overall Bandwidth	10 kC/s at the 3 dB. points
Battery Drain	Approx. 2 milliamperes

M182A

Full technical information and applications data are available for all transistors in the S.T.C. range—contact:

Standard Telephones and Cables Pty. Ltd.

252-274 BOTANY ROAD, ALEXANDRIA
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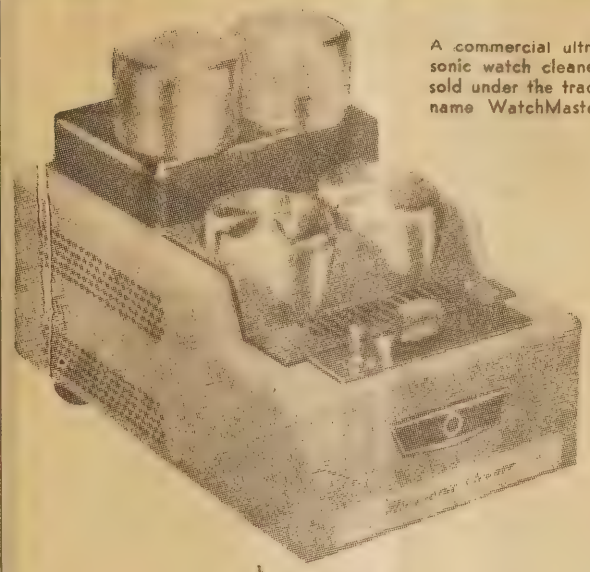
AN ITT ASSOCIATE

ULTRA-SONIC CLEANING --- LATEST AID TO INDUSTRY



A commercial ultrasonic watch cleaner, sold under the trade name WatchMaster.

The uses of ultrasonics have been growing by leaps and bounds. Among its applications in the medical field are the detection of cancer, destruction of harmful growths in inaccessible places and purification and emulsification of drugs. In industry, its uses range from tyre testing and inspection, drilling and machining of hard materials, and flaw detection to precise cleaning of precision parts and assemblies. If you've had a watch or piece of jewellery cleaned recently, the chances are good that the jeweller or watch-maker used an ultrasonic cleaner.

ULTRASONIC energy is simply mechanical vibrations whose frequency may vary from just above the upper limit of human hearing—around 20 kc—to well up into the megacycle range. It is generally developed by feeding the output of an audio or rf generator into a transducer which converts the electrical energy into mechanical vibrations.

The most common types of ultrasonic transducers are piezoelectric crystal magnetostrictive. The piezoelectric crystal may be quartz as commonly used in oscillator control and wave filters, or Rochelle salt, barium titanate or similar materials used in phonograph and microphone cartridges. When a high-frequency signal is applied, the crystal vibrates at the exciting frequency. The amplitude of the ultrasonic vibrations is greatest at the crystal's resonant frequency.

Nickel, iron, chromium, cobalt and their alloys and most ferromagnetic materials undergo a change in dimensions when placed in a magnetic field. This effect — called magnetostriction — varies with the material and the strength of the magnetic field. The most commonly used magnetostrictive effect is the change in length along the axis of the magnetic field.

OSCILLATING FIELD

When the magnetostrictive material is in a constant field, its change in length is minute. However, an oscillating field causes the material to contract and expand at a regular rate and set up ultrasonic vibrations. The amplitude of such vibrations is greatest when the length of the material is adjusted so it is resonant at the exciting frequency.

At resonance, the change in length may be as great as $L \times 10 - 4$, or 1 part in 10,000 where L is the length of the material. Off resonance, the change in length is generally limited to about 25 parts in 1,000,000. The magnetostrictive effect decreases as the temperature increases, and disappears at the Curie point. (At the Curie point, magnetic properties cease to exist.)

Magnetostrictive elements in transducers are generally made of thin rods, tubes or laminations, fastened together to make a core for the driving coil. This construction minimizes hysteresis and eddy-current power losses.

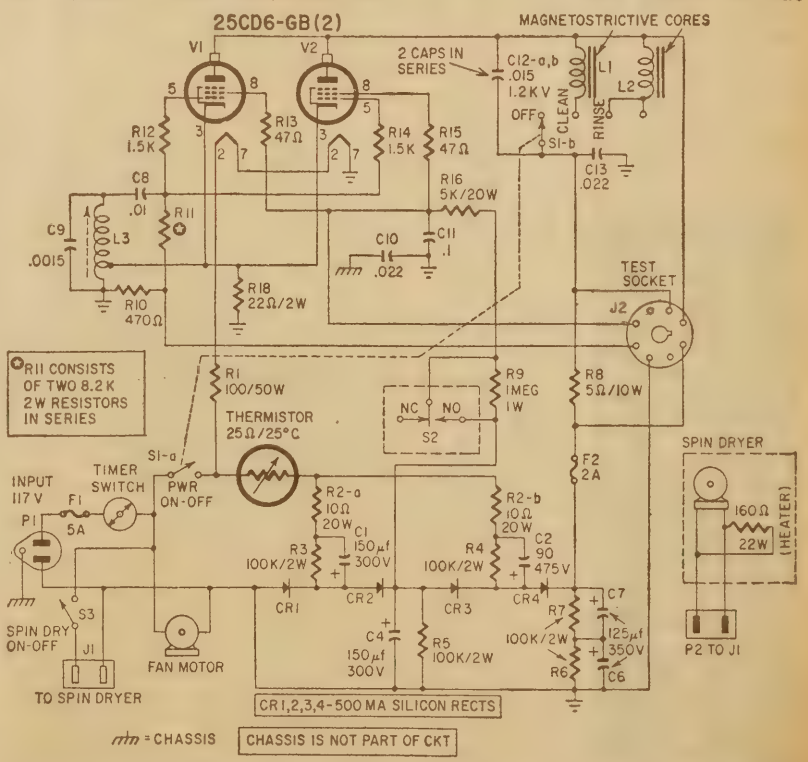
The selection of the type of ultrasonic transducer depends on the application and operating frequency, because the power in each wave varies inversely as the frequency. Crystals are much more efficient than magnetostrictive transducers, but are relatively fragile and cannot handle great amounts of power. They are used when the frequency is comparatively high and the power input is low.

Magnetostrictive devices are sturdy, they operate at lower frequencies and can be designed to handle almost any amount of power. But they are temperature-sensitive and may not be suitable where temperature approaches the Curie point.

Most cleaning operations consist of immersing the material to be cleaned in a solvent or detergent and scrubbing, either manually or by machine. In ultrasonic cleaning, the scrubbing action is obtained by setting up ultrasonic vibrations in the cleansing solution.

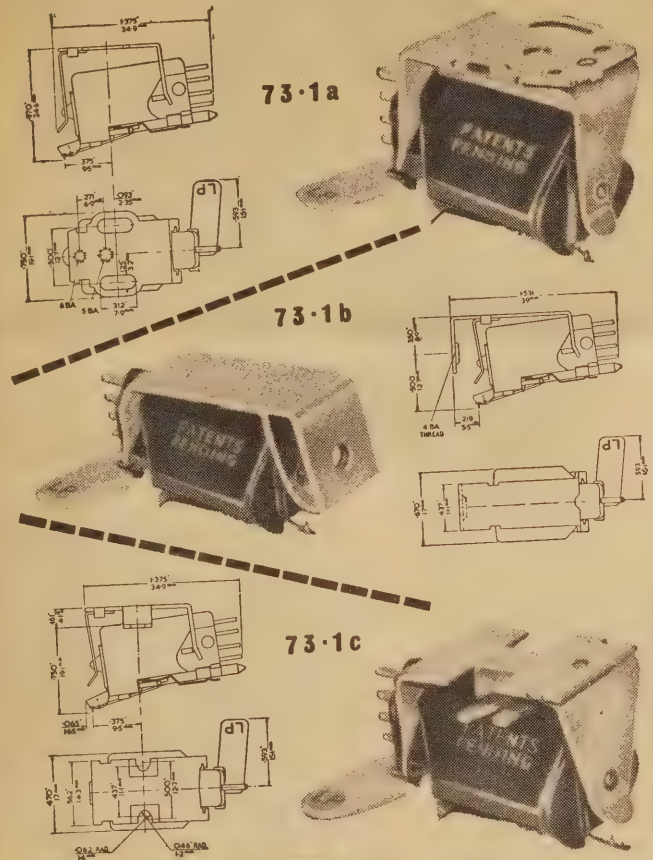
When a high-intensity ultrasonic beam is passed through a liquid, bubbles ranging from microscopic to very large are generated. These bubbles or cavities may be empty or filled with gas or vapour expelled from the liquid. This bubbling effect is called cavitation. The size of the bubbles and their make-up depend on the liquid and the ultrasonic frequency.

A considerable amount of power is stored in each of the millions of bubbles produced. As each bursts, it has an erosive action on solids immersed in the



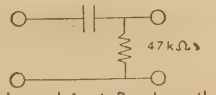
The circuit of the ultrasonic cleaner is basically an oscillator consisting of a pair of TV line output type pentodes driving the magnetostrictive cores. Additional circuitry provides timers for various processes

acos Crystal stereophonic cartridge



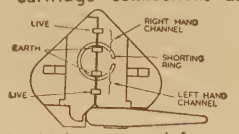
The "ACOStereo" 73-1 is a universal cartridge designed to play stereophonic and monophonic discs, including 78 r.p.m. coarse groove records. Three brackets are available. The "a" bracket fits the majority of arms, the "b" bracket fits Garrard RC. 110 and RC. 120 changers, and the "c" bracket is intended for American arms of the VM type.

The output from the "ACOStereo" 73 is flat when fed into a 2Megohm impedance. If record compensation is available in the amplifier, it is advised that the output is converted to constant velocity characteristics by feeding through this circuit:—



The left-hand channel is defined as the channel reproduced by the left-hand speaker when viewed by the audience, and is recorded on the left-hand groove wall when the record is viewed as:—

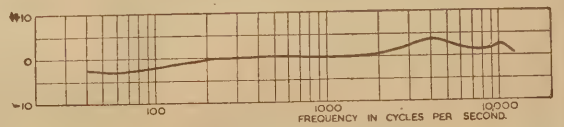
The "ACOStereo" cartridge connections as seen from the rear:—



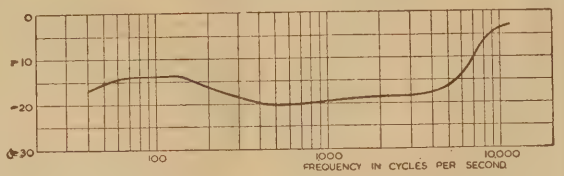
The shorting ring should be removed for use with amplifiers requiring separate leads.

PERFORMANCE OUTPUT — 160 m.v. at 1 cm/sec.
Average — 300 mv.

FREQUENCY RESPONSE—
40—12,000 c/s.
SEPARATION between channels at
1 K/cs better than 20dB.
Radii of Stylus tips—0.0005" (13.5 microns).
0.0025" (62 microns).
Recommended load: 2 Megohm.
(Compliance equals 3.5 ucm/dyne).
(Stiffness equals 0.0286 x 10 dynes/MM).
Recommended downward pressure: 3-4 Grammes.
The Stereo recording characteristics is within ½dB of the RIAA/BS 1928/1955 characteristics, and cross talk is better than — 20db at 1 K/cs.



Frequency response on PS.131.



Separation between Channels on PS.131.

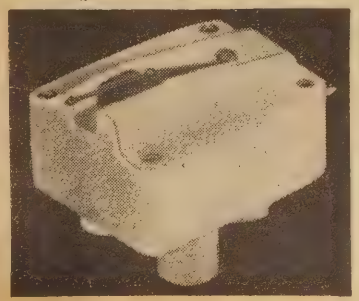
The response of both channels will be within 3dB.

All 73 series cartridges are available with two sapphire, sapphire and diamond or two diamond styli.

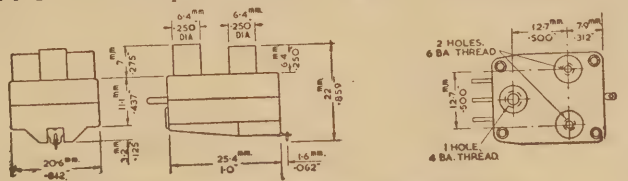
Prices: 73 series — Cartridge incl. 2 sapphire styli, £5/15/-, with sapphire and diamond styli £11/18/6, with 2 diamond styli £15/19/6.

Available ex stock.

'How Stereo Works" gladly posted on request.



71-3 For stereophonic and L. P. discs (non-turnover type).



With Sapphire stylus—Price £4/9/6
With Diamond stylus—Price £10/17/6

Australian Agents

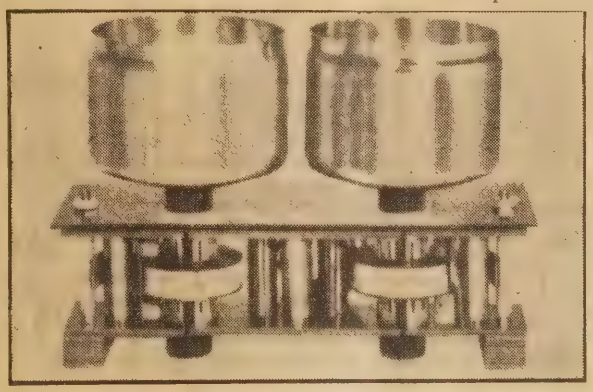
AMPLION (A/SIA) PTY. LTD.

101 Pyrmont Bridge Road, Camperdown.

SYDNEY, N.S.W.

liquid. It is this erosive or scrubbing action that is used in ultrasonic cleaning. One author compares the effect to the bursting of a bomb on the ground.

Another feels that it is caused by variations in hydrostatic pressure. On half of the excitation cycle, the pressure increases and forces liquid into the pores of the material. On the following half-cycle, pressure is released and the liquid erupts violently from the solid, carrying with it bits of surface material. No matter which explanation you accept, it is easy to see how cavitation is used for rapid removal of surface grime, dirt and film.



The cleaning cups are mounted directly on the magnetostrictive cores. Interlock switches turn the equipment to stand-by conditions when they are removed.

The size of the bubbles and the power in them decreases with frequency. At low ultrasonic frequencies, the bubbles are comparatively large and have enough power to do a good cleaning job on open surfaces but may be too large to penetrate deep recesses in closely fitted watches and similar assemblies. For cleaning watches, the optimum operating frequency is around 30 kc. In this range, the bubbles can penetrate the smallest recesses and have enough power for efficient cleaning.

This instrument, shown in the photos and diagram, is designed for rapid cleaning of watches, jewellery and small parts. The cleaning process consists of four phases: an ultrasonic wash, a dip rinse, an ultrasonic rinse and a spin-dry that whirls the watch or part in stream of warm air to remove the rinse solution. The ultrasonic wash, rinse and spin-dry are controlled by an adjustable built-in timer. S1 controls the ultrasonic wash and rinse, and S3 controls the spin-dry motor and heater when the timer is on.

The ultrasonic generator operates at 35 kc. Magnetostrictive transducers are used because of their high stability, power-handling ability and relative immunity to temperature rise during normal operation of the equipment. The transducers exert a magnetic pull when energised.

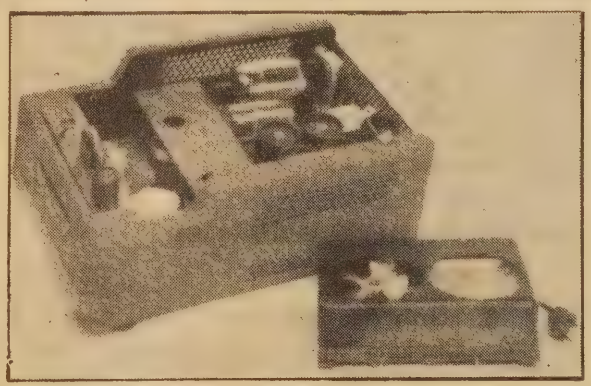
This effect is used to an advantage in the WatchMaster. The watch to be cleaned is demagnetised before being placed in the cleaner. Demagnetising releases all magnetic dirt particles clinging to steel watch parts and permits them to be removed easily by the cleansing operation. The transducer pulls these dirt particles to the bottom of the cup where they are held during the cleaning process.

The transducers are driven by an electron-coupled oscillator using paralleled 25CD6-GB's delivering more than 75 watts at 35 kc. The transducers are fastened to the bottoms of the wash and rinse cups.

The magnetostrictive elements are composed of approximately 40 nickel laminations radiating from a hollow brass tube. These elements are roughly ¾ inch in diameter and 2¾ inches long. They form the removable cores of driving coils L1 and L2. The coil selected by function switch S1-b is parallel-tuned to the operating frequency by the .015-uf capacitor.

The oscillator plate circuit is resonant at 35 kc only when the cores are in the coils, and the 25CD6's would be damaged if operated off resonance. S2 is a safety interlock switch that closes when both cores are in their coils. Removing either the ultrasonic wash or rinse cup opens S2 and inserts a 1-megohm resistor in the screen lead. This reduces screen voltage and cuts off the ocillator.

The violent molecular agitation of the ultrasonic wash and rinse produces heat in the liquid. A cooling fan blows a steady stream of air around the rinse and wash cups to hold the temperature down and to disperse vapour.



The electronic circuitry is contained in the body of the instrument. The two TV line output valves are visible in this picture.

The oscillator power supply is a transformerless voltage quadrupler using four 500 mA silicon rectifiers. The chassis is insulated from the power line. The line cord has a grounding type plug. The grounding terminal connects to the chassis and cabinet and protects the operator against a shock hazard in case of a short circuit.

SCIENTISTS TO 'FINGERPRINT' ATOMS

General Electric scientists at the Hanford atomic plant laboratories soon will place in operation one of the most advanced machines for "finger-printing" atoms.

GENERAL Electric craftsmen in Hanford technical shops and company engineers and scientists in the huge Hanford plant in south-eastern Washington have pooled their talents to build one of the most sensitive measuring devices in the atomic energy field. However, they obtained many of the components in the open market.

Called a mass spectrometer, the machine can be used to identify the isotopes in any element. In addition, it can provide an exact answer to the question of how much of which isotope is present.

Isotopes refer to an element's family. Lead, for example, has 17 different isotopes, four of which occur naturally—but all are lead. Each isotope has unique characteristics, its atomic weight being the most significant.

PLUTONIUM 240

This is important to atomic scientists. For example, the quality of plutonium varies depending on how much plutonium-240 is present in plutonium-239. PU-239 is the fissionable isotope. PU-240 is not. As with other elements, uranium varies in istotopic content. Natural uranium has 139 parts of uranium-238 to one part of uranium-235. U-235 is the fissionable isotope required to start and sustain a chain reaction, but the amount of U-235 present in uranium fuel elements fabricated for the big production reactors is an important factor.

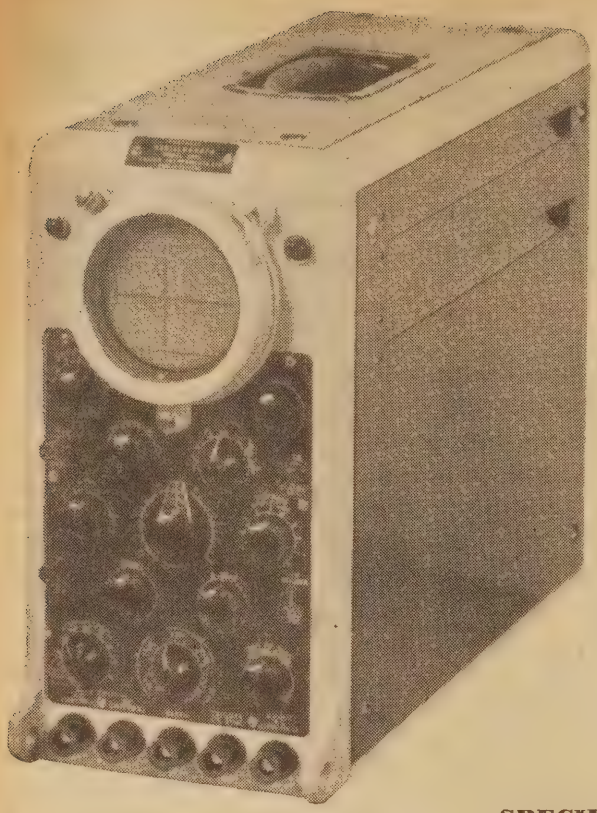
Since the various isotopes in one element are chemically identical, it is difficult to determine the percentage of a certain isotope in a sample. But no two isotopes have the same atomic weight (the number of neutrons and protons in the atom's nucleus), and the mass spectrometer uses this clue to gather precise data about the relative quantities of different isotopes in the mixture.

A sample of the test material is placed on a tungsten filament and ions are boiled off the metal much like steam is boiled off water. A vacuum tube about four feet long, two inches in diameter and curved like a boomerang, passes through the centre of a one-ton magnet.

As the ions flash up the curved tube they enter the magnetic field, where all the ions except those from one isotope are influenced according to their atomic weight to spray against the side of the tube as they fail to make the curve.

The machine is set so the ions from an isotope with a certain atomic weight will pass around the corner, travel on up the centre of the tube until they strike a detector at the tube's upper end. This data is transferred to a big electronic panel for interpretation.

Just as no two persons have the same fingerprints, the atomic weight of an isotope is a dead give-away to its identity. The spectrometer will be used at Hanford as a basic research tool.



COSSOR

SINGLE BEAM OSCILLOGRAPH

MODEL 1058

This Model is used by TV manufacturers and technicians throughout Australia and is fitted with a 4in diameter P.D.A. tube and provides a display of 6 cm. amplitude from zero frequency to 6 Mc/s. It has a direct coupled Y amplifier with a sensitivity of 0.25 V/cm and accurate calibrating facilities and a symmetrical X amplifier. The time base is free-running or triggered and has a wide range of scanning velocity.

Synchronization or trigger is by positive or negative-going pulses (switch-selected) either externally applied or via the Y amplifier and a special facility is provided so that time base trigger can be achieved from either frame or line synchronization pulses in a 1 volt D.A.P. (positive) television signal. The X amplifier provides a sweep expansion of up to five times. Time calibration is provided and measurements are made directly upon a calibrated scale.

Price: £175/10/- (plus sales tax)

Freight costs extra interstate

SPECIFICATION:

CATHODE RAY TUBE

Cossor single beam P.D.A. type 91D, operating at overall accelerating potential of 1.8 kV.

4in diameter flat screen with green trace.

TIME BASE

Triggered or repetitive.

Sweep expansion 5 times.

Five calibrated ranges giving spot velocities from 30 cm/sec. to 1.5cm/microsec. approximately.

Control of (repetitive) time base frequency over approximately 3:1 range by adjustment of time base amplitude this adjustment being independent of sweep expansion.

Ten-position trigger selector giving facilities for operation from positive or negative signals from external circuits or Y amplifier and also triggered operation from TV line or frame pulse on 1 Volt D.A.P. (positive) composite video waveform.

Continuously variable trigger attenuator.

Time calibration by shift control (10 per cent accuracy).

Y AMPLIFIER

DC to 4 Mc/s (—30 per cent) and 6 Mc/s (—50 per cent).

Separate AC input terminal giving LF response 30 per cent down at 20 c/s.

Maximum sensitivity 1 cm deflection for not more than 250 mV input.

Minimum sensitivity not more than 1 cm deflection for 200V input.

Eleven-position input attenuator with ratios 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 and 2000, all plus minus 5 per cent.

Rise time not greater than 90 millimicroseconds. Overshoot not exceeding 5 per cent.

Input impedance 1 Megohm, 50 pF to 2 Megohms, 45 pF.

Voltage calibration by 0.5V plus minus 3 per cent DC source (at front panel).

X AMPLIFIER

20 c/s to 200 kc/s (—30 per cent) and 500 kc/s (—50 per cent) at min. gain.

20 c/s to 120 kc/s (—30 per cent) and 250 kc/s (—50 per cent) at max. gain.

Maximum sensitivity 500 mV/cm.

Gain control continuously variable over approximately 5:1 range.

Input impedance 1 Megohm, 30 pF.

TEST WAVE

10V peak/peak, test waveform at mains frequency available at front panel.

SIZE AND WEIGHT

Height 14½in. Width 8in. Length 19½in. (36.8 cm) (20.3 cm) (47.5 cm)

Weight 42lb approx. (19 kg).

INTERSTATE DISTRIBUTORS:

VICTORIA

Radio Parts (Instruments) Pty. Ltd.,
562 Spencer St., MELBOURNE.

Warburton Franki Industries
(Melb.) Pty. Ltd.,
355 Lonsdale St., MELBOURNE.

Homecrafts Pty. Ltd.,
100 Leicester St., CARLTON.

QUEENSLAND

B. Martin Pty. Ltd.
Charlotte St.,
BRISBANE.

Chandlers Pty. Ltd.,
Cnr. Charlotte & Albert Sts.,
BRISBANE.

SOUTH AUSTRALIA

Cornell Electronics Ltd.,
59 Hyde St., ADELAIDE

Gerard Goodman Ltd.,
192 Rundle St., ADELAIDE.

Newton McLaren Ltd.,
17 Leigh St., ADELAIDE.

F. R. Mayfield Ltd.,
11 Halifax St., ADELAIDE.

SOLE AUSTRALIAN AGENTS:

JACOBY MITCHELL & CO. PTY. LTD.

469-475 KENT ST., SYDNEY — PHONE: MA8411

MELBOURNE OFFICE: 113 BRIDGE RD., RICHMOND

NEWCASTLE OFFICE: 135 BEAUMONT ST., HAMILTON

NEWS AND VIEWS OF THE MONTH

Britain discusses new TV standards

PROSPECT of Britain adopting the 625-line standard in television is being discussed at trade levels in view of official proposals for an eight megacycles spacing in bands 4 and 5.

The Postmaster-General's Television Advisory Committee, which is considering the technical problems covering standards of definition and colour in television, has made recommendations on the spacing of channels in future developments in Britain.

The committee points out that the rest of Europe is likely to adopt an eight megacycles channel in bands 4 and 5, and says it feels that in the interests of combined British and European planning Britain, too, should agree to an eight megacycles spacing.

One important result of such a decision on band spacing is that it governs the number of national programmes that will be possible on bands 4 and 5.

Although the committee points out that estimates must necessarily be approximate when the present state of knowledge of these bands is limited, it makes the tentative conclusion that with eight megacycles channeling there would be room for two programmes of 98 per cent. coverage, or two having 95 per cent coverage and one 90 per cent.

On the question of whether a 625-line standard should be adopted in Britain, the committee feels that at this stage judgment should be reserved pending further study.

If Britain did decide to adopt the 625-line standard favoured by most European countries the committee recommends that a six megacycles video band width should be used.

"The Times" says:

"The Television Advisory Committee's recommendation in favour of a television channel width of eight megacycles a second for bands 4 and 5 is clearly designed to provide adequate room for a 625-line system in those bands.

"This would not, of course, affect the existing 405-line definition standard.

Electronic Paymaster

THE British Air Ministry has ordered a £190,000 electronic computer to handle the payroll calculations of the 80,000 civilians working at the Ministry's headquarters and at airfields and establishments throughout the United Kingdom.

The computer — an EMIDEC 1100 being manufactured by E.M.I. Electronics Ltd. at Hayes, Middlesex — is expected to be able to complete the complicated calculations involved in the pay statistics in little more than half the working week. It is expected that in addition to the payroll the computer will eventually carry out various statistical and other tasks.

The calculations involved for the Air Ministry's civilian staff have to be made in accordance with an extremely complex code of regulations, and the computer will enable this work to be carried out more efficiently and economically than ever before possible. The EMIDEC will automatically prepare pay sheets, coin and note lists for cash wages, cheques and bank transfer slips for monthly staff and pay slips for all civilians.

A central pay office, where pay and personal records will be kept, is being established near Manchester, and the computer will form the nerve centre of this new establishment. It will be possible to provide at short notice detailed statistics concerning costs and numbers of staff employed throughout the country —either in grades and locations, or down to an individual's personal service record.

EMIDEC 1100 is one of the most advanced computers in the world and uses cores and transistors throughout which ensure a degree of reliability never before possible. The use of transistors means that size can be kept at a minimum and costly cooling systems necessary in thermionic valve machines eliminated.

The computer is scheduled to be delivered by the end of 1960.

Similar computers also have been ordered by the British Ministry of Labour, Barclay's Bank, British European Airways and the Royal Army Ordnance Corps.

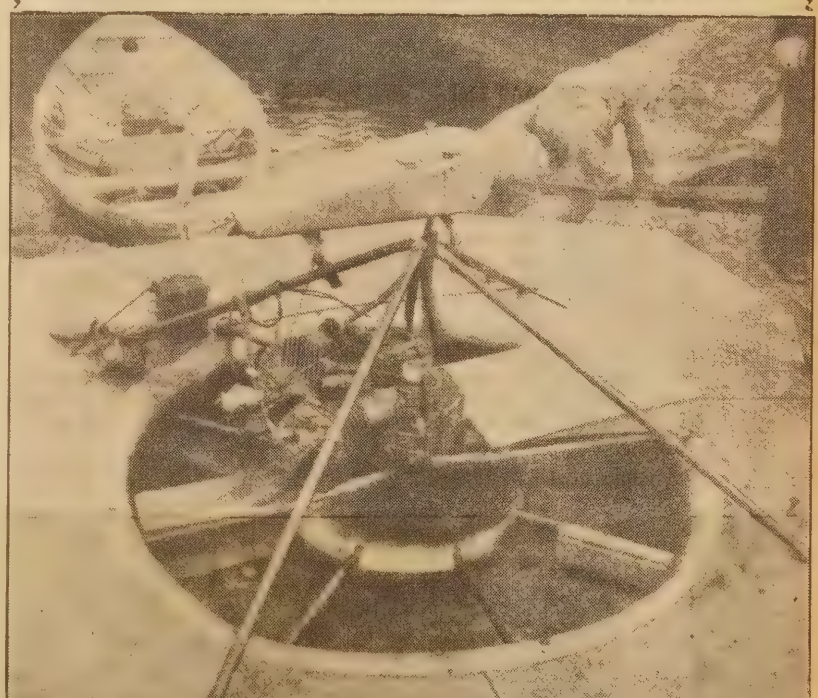
New Eurovision link

MARCONI'S have been awarded contracts from the Norwegian P.T.T. Administration and the Royal Board of Swedish Communications for a combined multichannel radio-telephone and television link between the Norwegian capital, Oslo, and Karlstad (Sweden). A further section, carrying multichannel radio-telephony only, is to be installed in Sweden between Karlstad and Arvika.

Between Oslo and Karlstad two two-way paths and one reversible one-way path are to be constructed. Both will operate in the super high frequency band (4,000 Mc/s). One of the two-way paths will carry 600 channels of radio telephony, while the reversible single-path system will carry television signals.

The second two-way path is to function as a standby for either. Broadcast

IS IT THE ORIGINAL HOVERCRAFT?



The claims and excitement caused by the British "Flying Saucer" — the Saunders Roe "Hovercraft" that recently crossed the Channel—has been received in Finland with mixed feelings.

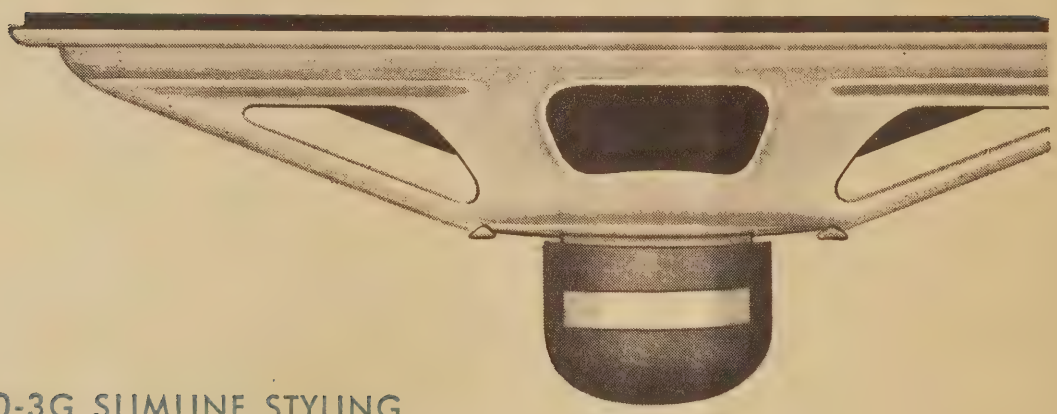
In the early 1930s, it is claimed, Finnish engineer T. Kaario built a "Flying Saucer" working on exactly the same principle — a cushion of air on water. Patented in Finland in 1936, his invention was powered by a 20 H.P. motor-cycle engine driving a horizontal "fan type" propeller.

Kaario claims to have written in 1950 outlining his invention to an Aviation magazine in Britain and to an aircraft plant. The magazine did not reply, and the aircraft plant merely thanked him for an "interesting letter."

Above is a picture of Mr Kaario's invention published in Finland in 1950.

Superseded!

TV "Side sound" now out of date



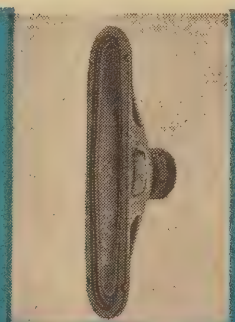
10-3G SLIMLINE STYLING

The Rola Model 10-3G loudspeaker ushers in a new era in TV sound. Prior to the development of this rather queer-shaped, but technically efficient, loudspeaker the sound from most table, portable and small console TV receivers came to the viewer from all kinds of odd angles. The aim of the designers of these types of TV receiver cabinets was to economise in space. To meet this requirement they mounted the conventional round or elliptical speakers so that the sound was bounced off the ceiling or radiated at right angles to the viewer. Never was the sound coming from the same source as the picture. Never was there the "marriage" between sound and sight so necessary to full realism.

Appreciating the problem Rola engineers set out to develop a loudspeaker which would really work under the exacting conditions imposed by space-saving TV set design.

The result justified their efforts for they came up with a loudspeaker which could be mounted vertically to reduce the width of the TV receiver cabinet, required no compromise in cabinet height and put the full audible range of the sound it reproduced just where the viewer wanted it — *right in the picture.*

The now available Rola 10-3G, the TV speaker of tomorrow, is here today!



Specifications

Power handling capacity	3½ watts peak
Diaphragm fundamental resonance	110 c.p.s.
Frequency response	105 c.p.s. — 6 K.C.
Voice coil impedance	3.5 ohms at 400 c.p.s.
Air gap flux density	8,800 Gausses
Total gap flux	18,200 lines
Transformer	Q or D
Principal dimensions:	
Overall diameter of diaphragm housing	10" x 2⅝"
Size of baffle opening	9⅞" x 2⅞"
Diameter of voice coil	⅝"
Depth from pad ring to rear	2¼"

ROLA COMPANY (AUST.) PTY. LTD.

THE BOULEVARD, RICHMOND, VIC., JB 3921. CALTEX HOUSE, KENT ST., SYDNEY, N.S.W., BU6147

speech circuits and control and supervisory signals will be transmitted via an additional radio link operating in the 400 Mc/s band. Between Oslo and Karlstad (190 km) there will be three repeater stations.

The path carrying the television signals will enable programs emanating from Oslo to be fed into the Swedish link and so into the Eurovision network; by reversing the path Oslo can take programs from Sweden or the Eurovision network.

The section from Karlstad to Arvika (multichannel radio telephony only) will also be a twin-path system with one path carrying 600 telephone channels and the second as a standby.

Marconi's have previously delivered many multichannel links in the 2,000 Mc/s band, but this installation represents the first order received for the new Marconi type HM.500 (terminal) and HM.550 (repeater) wideband multichannel equipments which employ an all-travelling-wave system and operate in the 4,000 Mc/s band.

The equipment uses the English Electric Valve Company's travelling-wave tubes throughout and is basically similar to the 2,000 Mc/s link, but scaled for 4,000 Mc/s.

A survey of the sites has been carried out and the system is expected to be in operation by May, 1960.

Radio telescope

A GERMAN firm has won a contract for a giant £750,000 radio telescope for the C.S.I.R.O.

Maschinenfabrik Augusburg-Nuernberg A.G. (M.A N.) won the job over tenders from British and American firms.

The radio telescope probably will be the most advanced and most powerful of its kind in the world. The Minister in Charge of the C.S.I.R.O., Mr Casey, said M.A.N. placed the lowest and most satisfactory tender. M.A.N. would place a sub-contract in Australia for part of the work.

He said the chief of the C.S.I.R.O.'s division of radio physics, Dr E. G. Bowen, played a leading part in completing the telescope's design.

STAFF VACANCY

How would you like a position on the technical staff of "Radio, Television and Hobbies?"

To become one of our permanent feature writers?

See page 55.

The telescope would be erected at Parkes, New South Wales. Work should be completed early in 1961. M.A.N. would begin to erect the telescope on a prepared site about the middle of 1960.

Mr Casey said the telescope would enable Australian scientists to maintain their prominent position in radio astronomy. Its most spectacular feature would be a radio "mirror," a saucer-shaped bowl, 210 feet in diameter and covered in wire mesh. This would pick up signals from the outermost fringes of space.

The "mirror" would be slightly smaller than that of the only other giant radio telescope in existence, at Jodrell Bank, near Manchester (England). The accuracy of the Australian telescope and the precision with which it could be pointed would be substantially higher.

STEREOPHONIC EQUIPMENT

POINTERS ON BUYING

BE CAREFUL OF YOUR FRIENDS

Your friend may have read a few more advertisements than you have. This does not make him an authority. Remain sceptical when he describes the X speaker as the only possible choice and has never heard it.

BE CAREFUL OF SPECIFICATIONS

One well known speaker has a useful frequency range of 30-14,000 cycles in England and 20-24,000 cycles in America. One popular stereo cartridge has a frequency range of 40-12,000 cycles in England and 30-24,000 cycles in Australia.

DON'T BUY ON NAME ALONE

Remember there is as much difference between a 8in and a 12in in some of the good speakers as there is between a G.M. Holden and a G.M. Cadillac.

DON'T SPEND TOO MUCH ON YOUR AMPLIFIER

Though there is a difference between a good and a superlative amplifier there is a far greater difference between a good and a superlative speaker.

DON'T TEST THE EQUIPMENT SOLELY ON DEMONSTRATION RECORDS

The number of persons who can tell the difference between a distorted and an undistorted train is very limited.

DON'T TRY TO BUY THE "BEST"

We don't know what it is and we have never met anyone who does. But with our wide knowledge of the equipment available and the music it is meant to reproduce we can help find what is best for YOU.

TO HELP YOU MAKE YOUR CHOICE WE CARRY A COMPLETE RANGE OF THE BEST EQUIPMENT.

LOUDSPEAKERS	PICK-UPS
VITAVOX	ORTOFON
WHARFEDALE	ELAC
GOODMANS	ACOS

AMPLIFIERS	MOTORS
LEAK	GOLDRING
ASTRONIC	GARRARD
AUDIOMASTER	NEAT
PARAMETER	COLLARO

WE DO ACCEPT TRADE-INS

Our cabinets will not appeal to those who consider ugliness is necessary for good reproduction. Our prices will disturb those who think good equipment must be fantastically expensive. But we feel that in each price range our value for money is impossible to beat.

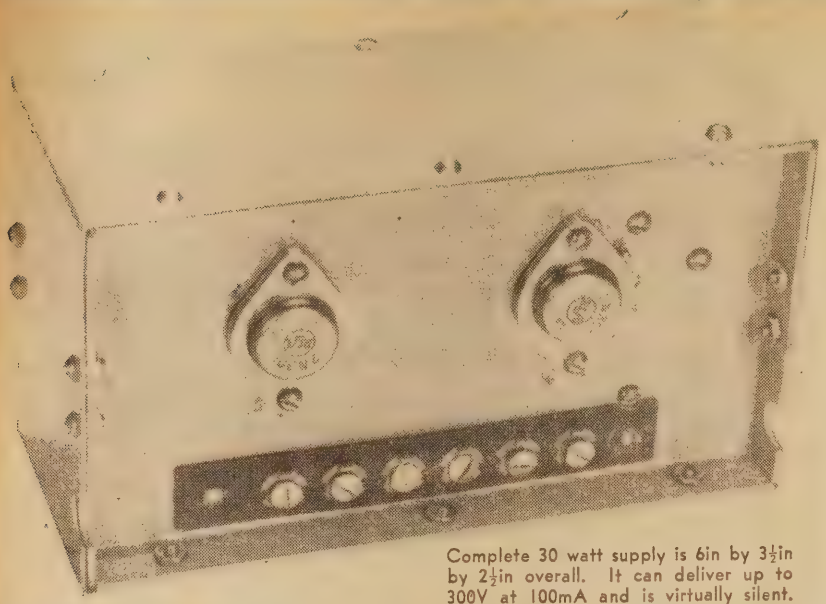
ENCEL ELECTRONICS

Enquiries — 354 Bridge Road, Richmond — JB2820

(5 minutes from Flinders Street)

361 Bridge Road — Showrooms.

For those who find evenings more convenient ring us and make an appointment at a time to suit you.



Complete 30 watt supply is 6in by 3½in by 2½in overall. It can deliver up to 300V at 100mA and is virtually silent.

Building a Transistor DC-DC Power Supply

Smooth, silent power is the feature of the transistor DC to DC converter, full details of which are given in this article. It replaces vibrator and genemotor supplies giving better efficiency, longer life and lower noise level, both in the mechanical and electrical sense. All parts, including the transformer, are readily available.

by Maurice Findlay

GIVEN the circuit and a couple of photographs of the mechanical arrangement, most of our readers could successfully complete the DC to DC converter described here.

Experience has shown, however, that most of our readers like to fully understand the operation of any equipment they build, particularly when it is something new to almost everyone.

Therefore we offer no apology for launching into a basic theoretical discussion before going on to describe the practical converter.

NEED HIGH VOLTAGES

Valves for high power and high frequency will not operate well on low voltages such as are readily available from portable accumulators; e.g., 6 volts, 12 volts and 28 volts are the standard supplies for cars, trucks, tractors, boats and aircraft. In general, potentials of the order of a few hundreds of volts are necessary in order to make small transmitting valves function efficiently and at rated power.

Practice in the past has been to employ either vibrator or genemotor supplies, the former for relatively low-power installations and the latter where large amounts of power are required.

The genemotor is virtually a DC motor driving a DC generator with the coils wound to suit the input and output voltages. A common electromagnetic field, powered from the low-tension side, is generally used, but the armature windings and commutator windings are quite separate.

Overall efficiencies for high-power machines can be as high as 70 per cent, but 50 per cent to 60 per cent is more usual for the types of genemotors used in radio installations.

In the genemotor, the changing magnetic field required for transformer action is provided by the rotation of the armature. In the case of a vibrator power supply the changing magnetic field is provided by switching a current, alternately in one direction and the other, through the primary winding of the transformer. The switching action is accomplished by the contacts of a vibrator which is vibrating at a steady rate.

Because there is a practical limit to the size of contacts which can be made to vibrate at a given speed, vibrator supplies are most generally suited to lower-powered installations. Efficiency of a typical supply overall is 60 per cent.

A basic vibrator power supply circuit, less rectifier and filter, is shown in Figure 3. The contacts of a simple vibrator are drawn as switches A and B, and when switch A is closed switch B is open and vice versa. The rate of opening and closing of the switches is determined by the natural frequency of the vibrating reed on which the contacts are mounted.

SWITCH REVERSES

Current through the transformer primary reverses as the switch positions change. This reverses the direction of the magnetic flux in the transformer core and induces a voltage at the secondary, determined by the turns ratio.

Waveform is essentially square rather sine law as in an ordinary mains transformer. A disadvantage is that there are many harmonics in the output which give rise to interference at audio frequencies and right through the spectrum to VHF. Extensive filtering is normally required.

On the other hand, the ratio of the peak to average voltage is small, which helps in maintaining good regulation and eases the required ratings of some of the components.

Output from the transformer secondary can be rectified and filtered with a valve and choke/capacitor combination. Sometimes the vibrator is provided with a second set of contacts which are synchronised with the primary set. These can be used to rectify the output of the transformer secondary and eliminate the valve rectifier. However, they have the disadvantages of tending to create still more interference, due to sparking and requiring a definite polarity for the input. (With the simple vibrator circuit and valve rectifier the supply will work with either polarity.)

DRIVING CIRCUIT

All types of vibrators require some form of driving circuit to operate the vibrating reed. One such circuit employs a separate driving contact and a solenoid. In the "at rest" position, the circuit through the driving contact and coil is complete and as soon as the power is applied the solenoid acts to pull the reed away from the driving contact and open the circuit.

The reed springs back to its original osition and the action is repeated at a equency largely determined by the echanical constants of the reed. The ction is the same as an ordinary buz- r except that the frequency is lower nd the parts generally more precisely onstructed.

Sparking at the contacts of the vibra- r is minimised by adjusting the natural sonant frequency of the transformer to incide with frequency of the vibrator. his is normally done by connecting a apacitor (buffer) across the transformer condary.

We have spent so much time discuss- g the vibrator supply because the ansistor power supply described here s a very similar action.

In the case of the transistor supply e collector to emitter path of the tran- stor behaves as a switch. Two tran- stors are used to replace A and B in gure 3.

ASE CURRENT

Opening and closing of the transistor itch is controlled by passing current the base/emitter circuit of the tran- stor. Power required to make the itching operate is quite small and can obtained from an auxiliary winding, we shall see later.

The resistance of the transistor used a switch is not quite zero in the "on" sition, nor is it infinite in the "off" sition, but the reduction in efficiency cause of this is not great. A good actical converter, in fact, has an effi- nce of the order of 80 per cent.

In practice, transistors have very im- rtant advantages. There are no mov- parts and therefore nothing to wear t. The switching action is able to erate much more quickly than in the e of a mechanical switch. As against 0 cps or so for a vibrator, the tran- or DC to DC converter can operate 2,000 cps or even higher.

Higher frequency means that the fil- ing requirements are greatly simpli- d. Small value capacitors and a low uctance choke will usually be satis- tory or sometimes a single large pacitor will reduce the ripple to a w level.

AGNETIC CIRCUIT

At higher frequencies, too, the maxi- m magnetic flux for a given num- of turns and power rating is smaller. hen becomes practical to replace the al iron core with a ferrite core which lighter physically, easier to assemble has lower losses at the higher fre- ncy.

Although the principle is very similar have now got around to something ich looks quite different from the al vibrator transformer.

As we have already mentioned, the tching action in a vibrator supply is ed by a mechanically vibrating reed since one of the objects of the sistor supply is to eliminate mov- parts, some other means is needed. esistance of the collector/emitter uit is controlled by the current flow- in the base-emitter circuit. This is trated in figure 4 where (a) shows condition with no current flowing in base circuit. The collector will then ent a high resistance and little cur- will flow in the battery circuit. This corresponds with the "switch open" position.

On the other hand if a relatively small current is made to flow in the base circuit, a high current will flow in the collector circuit. This corresponds with the "switch closed" position.

The ratio of the collector current to the base current depends on the particular transistor but with any good transistor, the power required to operate the "switch" is only a small fraction of the power controlled.

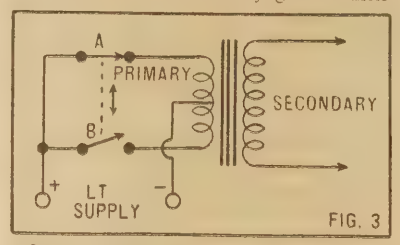


FIG. 3

Simple circuit is the basis of an ordinary vibrator power supply. Transistor supply works in the same way with the transistors substituted for switches.

The switching action can be made to be entirely automatic by including a third winding on the transformer, this winding being connected to the bases of the transistors. A functional circuit of the arrangement is given.

The action of the converter can be understood by reading the following explanation in conjunction with figure 5.

When the low tension input is applied, current flows through the forward bias resistor and the feedback winding to the bases of both transistors. This causes the "switch" action to take place and current flows through both halves of the primary winding and the collector-emitter circuit from the centre tap.

The current gain characteristic of both transistors will not be exactly the same, so that more current will flow in one half of the primary than the other. This means that currents will be induced in both the secondary and feedback windings.

The connections to the feedback winding are chosen so that the current in the base circuit of the transistor drawing the greater current initially is increased and the base current of the other transistor is reduced. Corresponding with the base current changes, the collector current of the first transistor will continue to increase and the collector current of the second transistor will decrease.

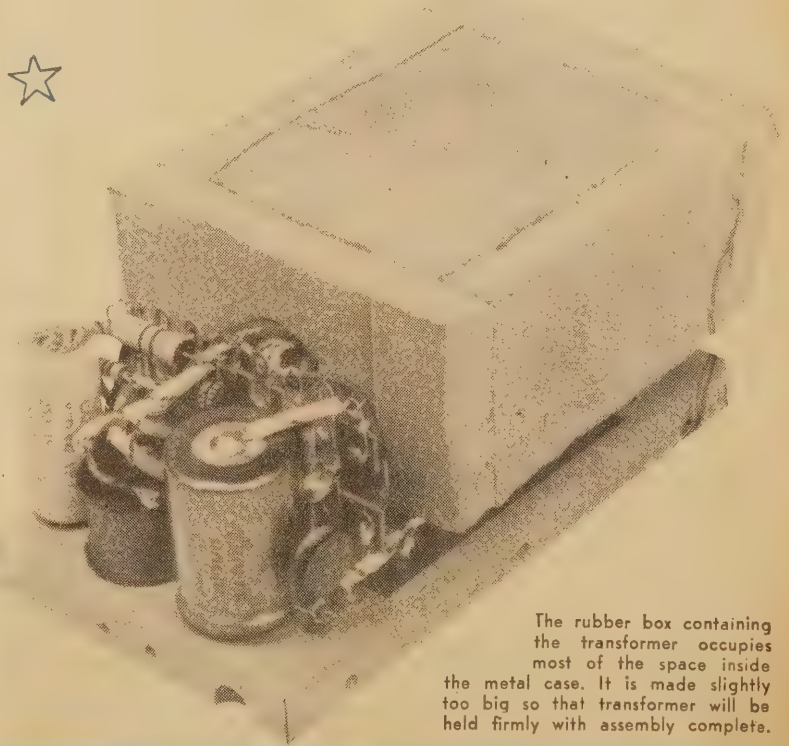
CURRENT CUTS OFF

Current applied in a reverse direction to the base of the second transistor by the feedback winding will soon exceed the current applied by the forward bias resistor and the collector current will be cut off. On the other hand the collector current of the first transistor will keep on increasing.

Eventually, the current through the half of the primary feeding the first transistor will be so high that the core of the transformer will be magnetically saturated. (The transformer is, in fact, designed to saturate at a definite level.)

No longer will there be a changing magnetic flux in the transformer and a current induced in the feedback winding. Base current and hence collector current, of the first transistor to conduct, will quickly fall from the maximum to a lower value.

In falling, however, a current opposite in polarity to the original is induced in the feedback winding. This reduces the collector current of the first transistor



The rubber box containing the transformer occupies most of the space inside the metal case. It is made slightly too big so that transformer will be held firmly with assembly complete.

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d increases the collector current of e second until the transformer core saturated in the opposite polarity. While power is applied and the load the secondary of the transformer is asonable, the action continues with al-rnate transistors conducting and the nsformer being saturated in opposite ections.

Saturation of the transformer core is ential to the switching action. Once s point is properly understood, there little more to the subject of DC to converters which is likely to give you uble.

The frequency at which switching takes ce depends on the inductance of the mary winding and the flux density for uration, in the main.

UST SATURATE

Fairly obviously, a special transformer required. An ordinary power transmer, even though it may have the rect turns ratio, will not be suitable. e inductance may be too high and the rent required to saturate the core may much too great for the transistors.

deal core material has small losses at required frequency, high permeability l saturates sharply when the maximum x density is reached. Ferrites find wide plication in transistor converter transmers while special iron alloy cores are o used. The latter usually work at er frequencies.

Output from the transformer secondy is substantially square wave in shape l has good regulation with respect to nging load. The ratio of the half nary to secondary voltages, Figure 5, equal to the turns ratio. After adding the number of turns on the pri-y, having regard to the required fre-ncy, input voltage and saturation flux sity of the core, the secondary turns be calculated by simple proportion.

A full wave centre-tapped winding, as sually employed in valve rectifier cirs, can be used. It requires that each of the winding be extended to the output voltage.

IDGE RECTIFIER

The bridge rectifier circuit needs a le untapped winding only and the rse voltage applied to individual recrs is only half that in the more com-n two rectifier, full wave circuit. Disantages of the bridge circuit are that equires four rectifiers and, if valves used, possibly three insulated heater dings.

ermanium and silicon rectifiers do require any filament winding but peak inverse voltage ratings are compared with valve rectifiers. refore, although four rectifiers are ired, the bridge circuit with germanor silicon diodes is often the best osition.

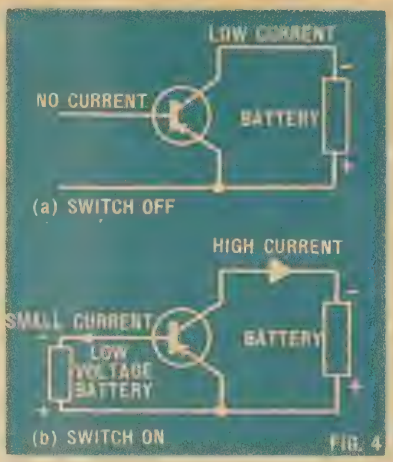
Where size is important, the semiductor diodes have the big advantage ccupying very little space. The set our usually occupies less space than valve rectifier.

hat largely completes a very general retical discussion on transformer led DC converters. There is another , which finds application in certain es, known as a ringing choke con-r. It is normally a single-ended uit, requiring only the one transistor. iency is excellent, but regulation is ively poor. It is not, therefore, as generally useful as the type described here.

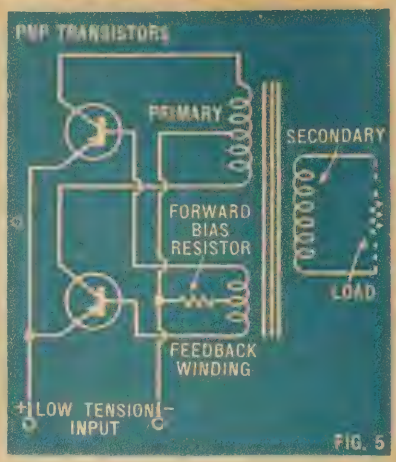
Design information of both types of converters has been published in many of the engineering publications. Little of this is of value to homebuilders because they rarely have either the time or the facilities to undertake the construction of components such as transformers from basic materials.

In this case, R. W. Steane and Co., under the trade name of Q Plus, have released a transformer designed to deliver 300 volts at up to 100 mA from a 12-volt DC source. The transformer was originally designed as the basis of a power supply to replace vibrator supplies in mobile radio-telephone sets. It employs a standard ferrite EHT transformer core as used in television receivers. Quantity production has made it available at a reasonable price

TWO CIRCUITS EXPLAIN OPERATION



The transistor used as a switch. A small current flowing in the base circuit is able to control a large current in the collector circuit.

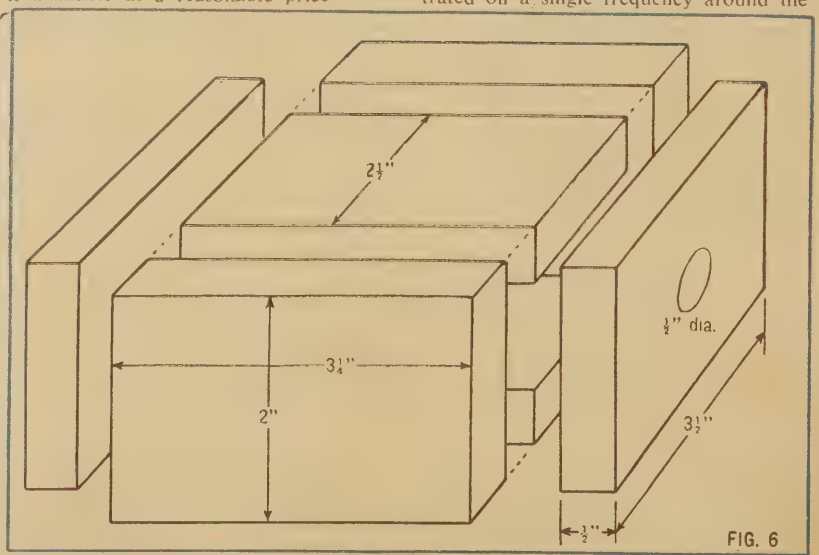


A basic transistor converter circuit. The changing magnetic flux in the transformer core feeds current back into the base circuits and controls the switching action.

Compact lightweight construction is essential in most mobile installations. Therefore, the newly available silicon junction rectifiers would appear to be the best solution. Their peak inverse voltage rating is not sufficient to permit them to be used in the two rectifier, full wave circuit, and the full wave bridge circuit is almost automatically dictated.

Therefore, the transformer supplied by Steane's has a single untapped secondary winding intended for the bridge circuit.

A problem which has given designers of transistor power supplies serious headaches is that of sound radiation from the ferrite core due to magnetostriction. The overall audio volume is actually not as great as that from a genemotor of the same power, but the fact that the audio energy is concentrated on a single frequency around the



Exploded view of the rubber container for the transformer. It is fabricated from ½in close-grained sponge rubber with contact cement. It should be assembled less end with hole, the transformer inserted, leads passed through hole and, finally, the end cemented in place.

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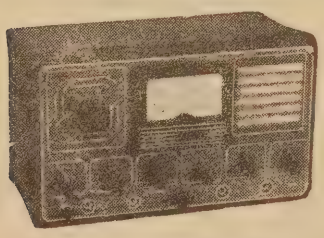

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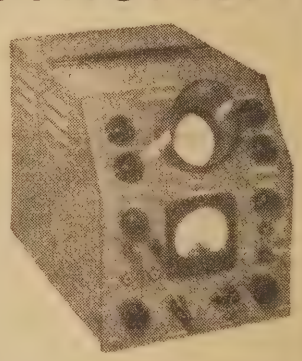

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ost sensitive part of the ear's range akes the sound particularly distressing ter the first few minutes.

Various solutions have been suggested id tried, with varying degrees of suc- ss. Even encapsulating the trans- rmer in resin does not completely cure e trouble.

The ferrite of the transformer itself ts as an effective radiator, while the fect is multiplied if the transformer is ounted on a chassis or metal plate, hich increases the effective area of e radiator.

We found that an excellent solution the problem of acoustic output from e transformer was to completely en- ose the transformer in a foam rubber ox.

OAM RUBBER

The box we used was made from ose-grained foam rubber ½in thick. The rts were cut to size with a large pair sharp scissors, according to the dia- am of Figure 6. Rubber or some form contact cement can be used to put e box together, when the finished joints ll probably be stronger than the foam bber material itself.

Dimensions given actually make a x slightly too big for the metal box, th the object of holding the trans- mer firmly in place.

At the same time, the rubber box is ilient enough to permit the mounting high permittivity disc ceramic bypass acitors right at the screw terminals.

Enclosed in the rubber box, but out- e the metal case, the acoustic output m the transformer is down to an ceptably low level even if an operator to be located quite close to the sup- . Noise is further reduced, to the int where it may be necessary to place ur ear close to the metal case to make e that the supply is operating, when rubber box is finally installed in the mplete unit.

Should the power supply be installed some place remote from the operator re may be no need to include the ber-sound insulation and the overall mensions could be made even smaller. the same time, the present overall mensions of only 6in by 3½in by 2½in luding all high frequency and low fre- ncy filtering compare more than ourably with the equivalent in a rator, genemotor or even an AC ins supply.

ANSISTORS INSULATED

As you will note from the photograph page 32, the transistors are mounted a lid with the lip projecting outwards. ey are insulated from the lid with thin a washers. These will be supplied h the transistors in the normal way could be cut from scrap pieces of ha.

he idea is to split the mica as thin possible. A razor blade will help you may be able to get an un- naged washer down to about 0.005in. er the experience of making a few hers, we have decided that it is er to split the mica first and cut to afterwards.

he lid of the case also behaves as heat sink" for the transistors with an red effective area equal to the out- surface area of the lid. In practice e heat will also be transferred to the osphere by the rest of the case due to the fact that the case and the lid are bolted together.

Despite the fact that the transistors are converting a relatively large amount of power, the average dissipation is not very great and therefore the heat sink area need not be as large as for a push-pull class A stage delivering 10 watts, for example.

The reason for this is that the transistors spend most of their time in a virtually non-conducting or fully conducting state. In both cases the product of the voltage and current in the collector/emitter circuit is small and therefore the power dissipation is small.

When the switching operation is in progress, the transistor does pass through a high dissipation condition but since this occupies only a small part of the cycle, the average dissipation is still low. This, by the way, is one of the reasons why there is an upper limit to the frequency of a transistor supply. If the switching time becomes too large a proportion of a cycle, the transistor dissipation increases and the efficiency decreases also.

PROTECTION

The outwards turned lip of the lid offers protection for both the transistors and the screw terminal board and makes it less likely that the transistors will touch external metal objects and cause a short circuit.

Both the low tension circuits and high tension circuits in the supply have been insulated from the case. Either polarity may therefore be used for both the input and the output, the only limitation being that the potential difference between terminals of the RF bypass capacitors must not exceed the ratings of the latter. If there is a special need, you can order special capacitors but the usual type are rated at at least 500 volts and are more than adequate.

Ripple on the primary line is virtually eliminated by a large electrolytic capacitor and an RF choke. Actual value of the capacitor is critical only in the sense that it may need to be increased if a practical trial indicates that interference is getting into low level heater lines. In many cases a lower value would be satisfactory. The radio frequency choke is a simple air core type as often used in vibrator power supplies. Its resistance should not be greater than about 0.15 ohm.

FUSE ARRANGEMENT

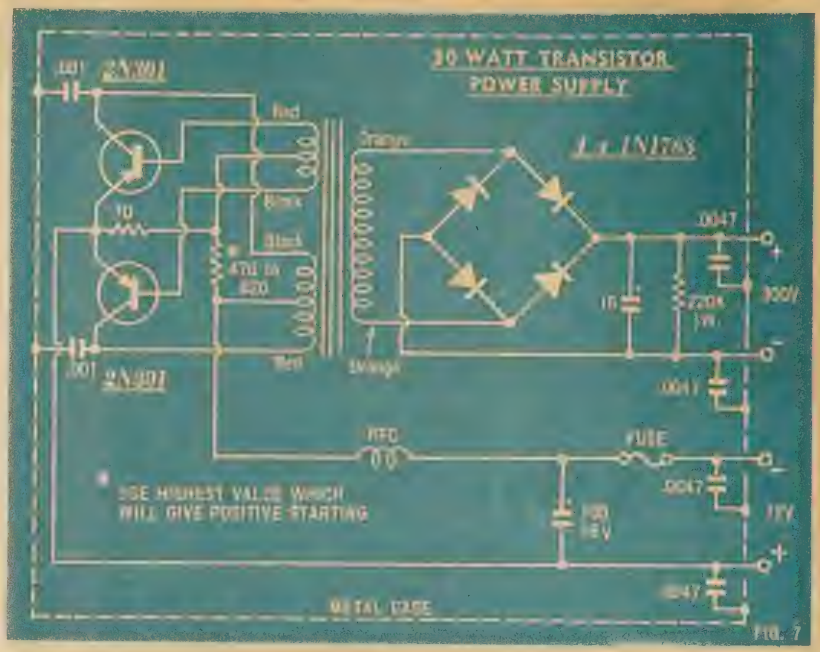
The fuse is a single strand of .01in tinned copper wire held between two screws of the terminal strip. It will protect components in case of an internal short.

Connections to the transformer are identified by the colour code shown in the circuit. A possible confusion is between the primary and the feedback winding. The feedback turns are wound with the thicker wire.

A divider circuit is included in the base circuit of the transistors in order to bias them sufficiently far forward to ensure positive starting. The amount of current bias required depends on the particular transistors. We suggest that you start with 820 ohms at the top of the divider and reduce the value until the supply starts satisfactorily. If a value lower than 470 ohms is required we would suggest that you begin checking the transformers, transistors and other components as well as the circuit connections.

Bypass capacitors from the collectors

CIRCUIT DETAILS OF THE SUPPLY



Complete circuit of the supply. Capacitors bypassing transistor collectors to case will only be required when the supply is used with a very sensitive receiver. In extreme cases, an RF choke in the HT line may also be desirable.

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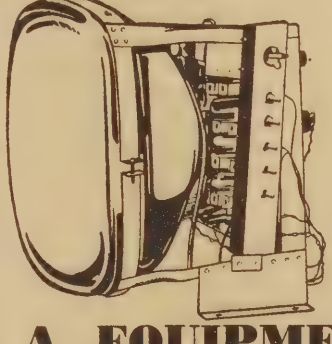
* 6 diodes used where applicable.
* Fringe area set, 4—IF stages, 90 degrees short neck tube electrostatic focusing.



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f the transistors to the metal case need nly be included if trouble with RF in- rference is experienced. Their purpose to prevent radiation from the col- ctors which are external to the case.

Transistors type 2N250 have charac- ristics very similar to the 2N301 and lthough we have not actually tried them, e can see no reason why they could ot be substituted.

Four 1N1763s in a bridge circuit are onnected across the secondary of the ansformer and deliver rectified current. ecause the frequency is so high, a ngle 16uF electrolytic capacitor brings ie ripple down to a level which will be ceptable for most applications. A re- stor across the output ensures that the apacitor discharges within a reasonable me.

'SE LOAD ALWAYS

It is not advisable to operate the sup- y with no load because there are peaks n the transformer output waveform hich, without load, could cause the tings of several components to be ex- eded. The duration of the peaks is ort and even with a small load all will in order.

A check with a wide band oscillo- ope indicated that the amplitide of the oltages applied to the transistors was ell below their maximum ratings. herefore no special despiking networks ere found to be necessary.

For the bridge circuit, there are other pes of rectifiers which should be ually suitable. Type OA210 has simi- r ratings to the 1N1763. The 1N1764 rated at a higher peak inverse voltage nd the only reason you would not choose this type is that it is more costly.

On the other hand it would permit a transistor power supply capable of delivering a higher output voltage provided the secondary winding is provided with extra turns.

There is a possibility that a further transformer will be introduced at a later date with an extended winding to allow up to 400 volts output if required. The maximum current at the higher voltage would be correspondingly reduced.

At heavy overloads the output voltage of the supply will fall quickly and the efficiency will be poor.

HEAVY OVERLOADS

Actually a direct short circuit will not damage any components in the supply. The circuit will stop oscillating and the input current drop to a low value until the short is removed.

Bias for various stages in transmitters and amplifiers is sometimes obtained by passing the entire current of the supply through a dropping resistor and using the potential drop across the resistor. Sometimes a disadvantage of this is that more power than necessary is dissipated.

Since the number of turns required is few, it is a simple matter to add a special winding on the transformer for bias as required. A bridge rectifier using some small germanium diodes can be made quite cheaply and a single electrolytic capacitor will give satisfactory filtering in many cases.

The subject of DC to DC converters in general is by no means exhausted and we hope to publish designs for converters of various other power ratings before too long.

NEWSPAPER DISTRIBUTED BY WIRE

Facsimile techniques are being used by the Japanese newspaper Asahi Shimbun to speed distribution. The first of its kind in the world, the system uses facsimile transmitters and receivers supplied by the British Muirhead Co.

WITH the new system, morning and evening newspapers made up in kyo can be printed in Hokkaido, the st northern island of Japan, and be tributed there almost at the same ie as in Tokyo. The link runs be- en Tokyo and Sapporo, a distance of ut 500 miles.

Similar systems between Tokyo and aka, a distance of about 250 miles, l one other centre on the main island planned.

A newspaper page to be transmitted is apped around the drum of the trans- ter and a small area of the copy htly illuminated. Through an objec- lens an image of this area is pro- ed and focused on to a small white en. A small rectangular aperture in screen allows light from an element he image to fall on the photocathode a photomultiplier cell, which produces electrical voltage proportional to the unt of light. This voltage controls the strength of the signal sent to the receiver.

During transmission, the drum is rotated and the optical system carrying the illuminating lamps and the photomultiplier cell is slowly traversed parallel to the drum axis.

The entire newspaper page is thus scanned line by line in the form of a close spiral. At the receiver, film is wrapped around a drum contained in a light tight box. The drum is scanned, and the film exposed in the form of a close spiral, the facsimile copy of the newspaper page being built up in a series of parallel lines.

In order to deal with the fine detail in Asahi Shimbun, the equipment uses a scanning rate of 300 lines per inch.

The design is based on a 48 Kc, 12 channel frequency band, which is most readily assimilated into a carrier telephone system, the actual frequency band used being 60 to 108 Kc.

To obtain the highest rate of page transmission within this bandwidth without making a stringent demand on the quality of the communication circuit, it is arranged to transmit two "programmes" simultaneously and for the drum speed to be 180 revs. per minute. With this speed, each transmitter can transmit a newspaper page measuring approximately 23 by 17 inches in 27 minutes. Two transmitters working simultaneously can, therefore, transmit four pages in an hour.

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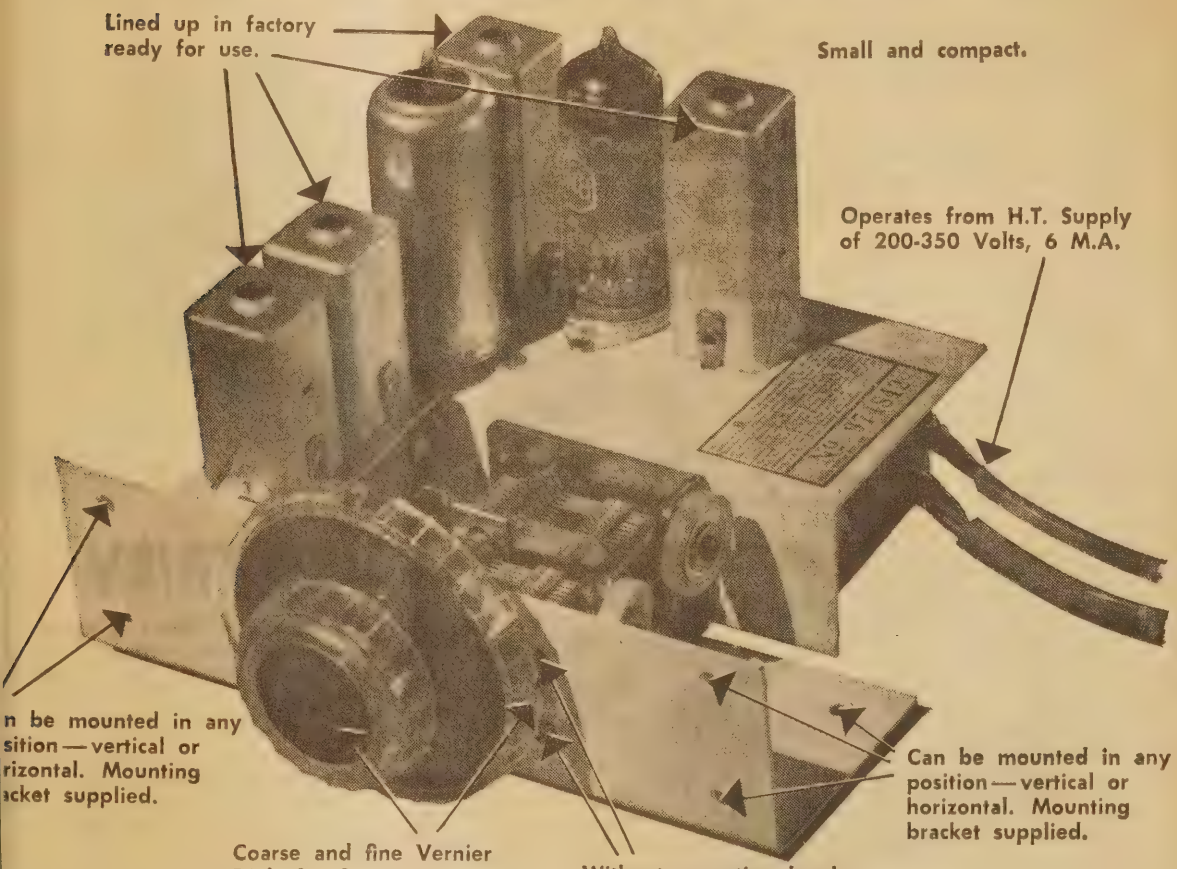
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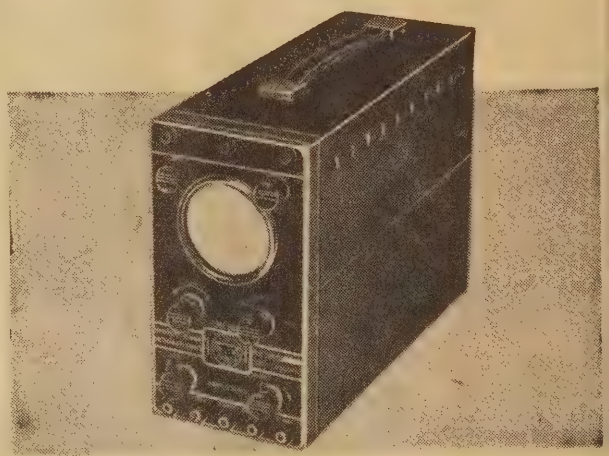

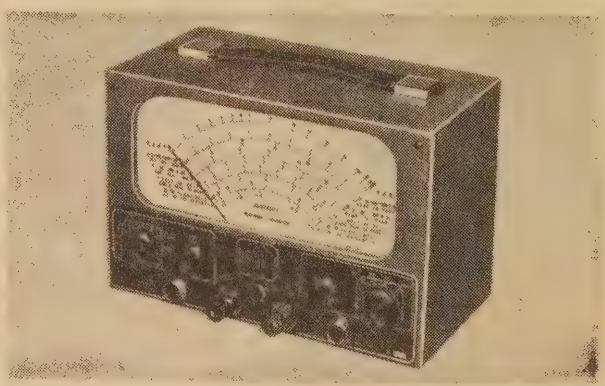

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This smartly styled University Model Electronic Voltmeter is a basic measuring instrument for every branch of electronics. Model TVR/EV operates from 240 volts A.C. mains and is supplied with instruction booklet, circuit diagram D.C. voltage probe with inbuilt isolating resistor, A.C. voltage probe, ohms probe and earth lead. Available accessories are a 30,000 volt D.C. probe, a radio frequency crystal probe up to 30 volts at 250 m.c. and a valve probe enabling radio frequency voltages to be read up to 1000 volts at 200 m.c.

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16/FP.23

FROM THE SERVICEMAN WHO TELLS

"People are funny" is the theme of a well known overseas quiz session, but it doesn't stop with the program side of the game. Take any group of TV set owners talking to their local servicemen and you can be sure a percentage will come up with some of the most cockeyed ideas you've ever heard. I have a couple to relate this month.

BUT before relating my own experiences, I want to acknowledge a couple more letters on the subject of the mysterious silver growth between valve pins which was discussed in some detail last month.

One of these, from Mr P.B.T., of Coogee, N.S.W., is reprinted on this page, and it tells its own story. I found it interesting for a number of reasons, not the least being that it emphasises that other people have their troubles, too. And, as the writer points out, they are troubles which are not always as easily fixed as in a radio set.

The other letter is from Mr D.P.D., of South Australia. It contained a cutting from an overseas magazine concerning the growth of "whiskers" on metal and the suggestion that this may be an explanation of the silver migration on valves or other mysterious short circuits occurring in radio equipment from time to time.

COINCIDENCE

By a singularly happy chance I happened to walk into the Editor's office around this time, and found him preparing an article for publication on this very subject. Glancing quickly through the rough copy I was most interested to note that these "whiskers" were, in fact, first discovered because of mysterious short circuits in electronic equipment.

Since the whole subject is an extremely interesting and important one in its own right I won't attempt to delve any further into it in these columns. Instead, I suggest you read the whole story as told elsewhere in the magazine.

Of course, there is no guarantee that the two phenomena are related, but it would seem to be a rather remarkable coincidence if there is not some connection somewhere. (No pun intended!)

In any case, my sincere thanks to both these two gentlemen for the interest they have shown and the trouble they have taken to write to me about it. I am sure readers will find the whole subject an extremely interesting one.

CUSTOMER COMMENTS

From time to time I make notes of various minor incidents and remarks which I encounter in the ordinary run of business, and which appeal to me as either amusing or indicative of the general public's view of radio and TV.

These are usually pushed into a corner of my drawer along with more substantial story notes and, because it is not always possible to use them immediately, tend to grow into quite a pile. Then I am forced to take some notice of them, simply by reason of the space they occupy

This is just such a time, so I have decided to present a couple of the best of these.

As an introduction to my first story, I should mention that I appear to have been encountering an unusually high percentage of TV sets suffering from the same fault; loss of picture height. This may, of course, be mere coincidence, or it may be the result of a simple cycle of events whereby sets which went into service around the same time are now commencing to show the same signs of age. But, whatever the cause, I do seem to have encountered a run on this particular fault.

It usually means that the vertical output valve is on its last legs, resulting in a routine replacement and a check on relevant controls in case the owner has been boosting the height from time to time.

Which brings me to the first point of the story. Since it is perfectly reasonable to offset small losses of height by adjustment and thus save the owner the cost of a new valve for a few months at least, is it advisable to instruct the average user how to do this for himself?

I was encouraged in this idea by the fact that some owners already do so, mainly where the control is readily accessible on the front of the cabinet, and that they seem to avoid getting into too much bother.

On the other hand, so many of them seem incapable of even adjusting the fine tuning control, that I hesitated to make this a general rule and decided that it should be reserved for those cases where the owner seemed to have some idea of what it was all about.

This, then, was my frame of mind when I encountered one of my strangest customers. He started off by complaining that his TV picture suffered from ". . . a black band coming in from the top and bottom of the picture." (Which is another point; this trouble is invariably described as a black band encroaching on the picture, never simply as the picture losing height.)

CLASSIC STATEMENT

Anyway, our friend, having described the trouble, went on to ask whether he could adjust the trouble himself. Then, while I hesitated for a few seconds trying to make up my mind whether he was equal to the situation, he made the decision for me with what must be regarded as a classic statement.

"I thought I might be able to take the back off and fix the film so that I don't get the black bands any more."

I'm afraid I boggled at that one. Not caring to trust my hearing I asked him to repeat the statement; which he did. This time I was sure there was no mistake, he distinctly used the expression, ". . .fix the film. . .", though exactly what he meant by it I'm afraid I can't imagine.

Did he really believe that the set used film? That it was a kind of glorified 16mm projector operated by remote control from Gore Hill? Or was the word "film" used in an abnormally broad sense to imply anything on which a picture appeared—in this case the screen?

NOT THE TYPE

I'm afraid your guess is as good as mine. To learn more of what he thought would have involved prying deeper than serviceman-customer relations could reasonably be expected to stand. But you may be sure on one point; I quickly assured him that it would be far too risky for him to tackle the job himself, and made an appointment to check the set myself.

Imagine a character with that kind of outlook probing the innards of a TV set.

And from pseudo photography we go to the real thing. This story is typical of several, for it is surprising the number of people I have encountered who have fallen into the same trap. Once again it emphasises how seldom it is that even

---

Dear Sir,

I was interested to read your remarks concerning the "growth" of silver between valve pins and I thought you might be interested in the following.

First let me state that I am a telephone technician employed by the P.M.G. Department.

For several years it has been noticed that a disproportionate number of faults were occurring at the jack points of certain racks of automatic telephone switches.

When examined, the fault would be found to be a burning of the bakelite between adjacent contacts, caused by the "growth" of silver from the silver plated contact of the jack, causing a flow of current which heats and burns the bakelite, causing more current to flow, burning more bakelite, and so on . . .

In our case the cure is not as simple as in yours. All silver plated jack points in all telephone exchanges must be replaced within the next few years with jacks of an alloy similar to that used in relay springs.

I note that certain carrier telephone equipment now being installed has gold plated jack points. Let's hope these give better service.

Yours Faithfully
P.B.T. (Coogee, N.S.W.)

The WARBURTON FRANKI PAGE

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The LEAK TL12, £105/13/-. **The Leak TL25,** £125. For Stereo. The Leak Stereo 20, £147.

The Leak Stereo Pre-amplifier is available separately at £60

The AEGIS-MULLARD 5/10 Amplifier £40/5/

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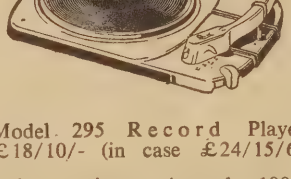
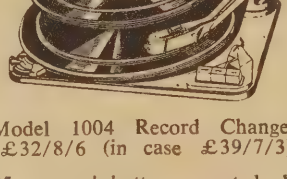
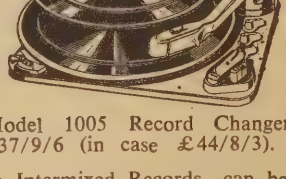


Model 295 Record Player £18/10/- (in case £24/15/6).



Model 1004 Record Changer, £32/8/6 (in case £39/7/3).



Model 1005 Record Changer. £37/9/6 (in case £44/8/3).

Above units are 4-speed. 1004 and 1005 are push-button operated—Will handle Intermixed Records—can be manually operated—will repeat if desired.

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he most elementary principles of TV re understood.

This story started while Mrs Serviceman and myself were visiting some friends; a family of keen TV viewers. The subject of TV programs cropped up nd the conversation eventually turned o the recent visit of a popular teenage dol and his appearance on TV.

At this, the teenage daughter fished ut a paper wallet of snapshots and produced one showing the performer and is troupe arriving at the airport—but, airly obviously, taken from the TV creen.

She was extremely proud of it and, ll things considered, it was a remarkbly good picture. She had used only a imple box camera, loaded with ortho lm, and had simply pointed it at the V set and clicked the shutter. To be ure, the picture was somewhat out of ocus (due to working too close to the ubject), slightly off centre (due to view inder parallax at such a distance), and ow in contrast, but it was a recognisable icture.

SURPRISING RESULT

I must admit I was surprised that she ad obtained anything at all under such onditions, since my own experience has lways suggested the need for a oderately fast film, a large aperture ens, and a camera which would focus to within a few feet of the TV screen. I ertainly would have hesitated to predict he results from such a simple set-up, and aid so when complimenting her on the esult.

Then I learned that her parents had xpressed similar doubts before she took he picture.

"I told her she was only wasting lm," said her mother, "I didn't think he could possibly get a picture."

"Nor did I," said her father, "I told er she wouldn't do any good without flash; and we didn't have a flash, although there are contacts on the amera."

See what I mean. It took quite a ew minutes of detailed explanation on ny part to get across the idea that a ash—or, indeed, any form of auxiliary ghting—could not possibly help and ould only make things worse, possibly esulting in no picture at all.

I must admit that they did catch on hen I put the problem in simple nguage, but I feel that the story is ndicative of the average person's lack of nought on such subjects. And, as I said arlier, this was by no means an olated case.

V PROBLEM

My most interesting case this month oncerned a TV set with severe disrupon of the horizontal synchronising net-ork. I use the word "disruption" beause it was not a complete failure, ather a partial one which gave some ery funny and, to the owner, disturbing ffects.

Although the picture could be made hold, it would do so only with diffiulty and by very careful setting of the old control. Even then it was pulled adly by the video content of the icture, verticals bending this way and hat as people moved across the screen, nd close-ups of faces being twisted into otesque shapes reminiscent of the disorting mirrors in a fun parlour.

Another trick it produced was to suddenly shift phase somewhere in the deflection system, so that the black blanking bar normally forming the vertical edges of the picture flicked into the centre, dividing the picture into two halves, one on each side. As far as I could see, this happened mainly when there was a black vertical line somewhere around the centre of the picture and which was being mistaken for the synch pulses.

Quite naturally, the owner was very worried about it. Not so much because he had already missed a couple of his favourite programs, but because he found it hard to believe that any set capable of such dreadful pictures could ever be expected to perform normally again.

While doing my best to reassure him I couldn't help reflecting that a good many people react this way. Not being able to visualise anything beyond the screen and the control knobs, I suppose it is only natural to judge a fault purely on its effect on the picture. Thus a badly disturbed picture must mean a serious fault, a costly repair, and the risk that, unless the serviceman is very skilled, there may always be a vestige of the trouble remaining.

Just how wrong this assumption can be is amply demonstrated by this story.

Closer examination showed that the vertical hold also left much to be desired even though, being by nature a less critical circuit, it could be made to hold by careful setting of the control. I also established that increasing the contrast helped matters, while decreasing it made them much worse.

UNWANTED VIDEO

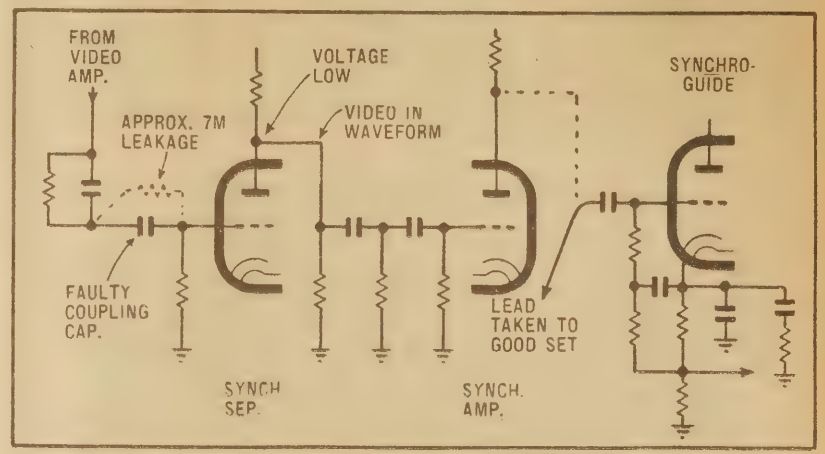
One thing seemed certain, somehow or other an awful lot of video was getting past the synch separator and into the oscillator circuits; hence the violent pulling. The fact that increased contrast helped seemed to suggest something in the synch. separator itself and my first guess was a defunct synch. separator valve.

However, when an on-the-spot replacement made no difference, I decided that this one had better go back to the shop. After all, there is a limit to what can be done on someone else's lounge room floor.

Back at the shop I pushed the set onto the bench and realised that a chassis already there came from an identical set; one that had come in the previous day for a routine type of repair. It occurred to me that this might be a happy coincidence.

A quick check of the circuit showed it to be a fairly conventional arrangement; a twin triode as synch. separator/amplifier and another in a conventional Synchro-Guide type of circuit.

More to prove the feasibility of the idea than anything else I quickly lifted the lead connecting the Synchro-Guide valve to the doubtful synch separator, connected a scrap of hook-up wire to it, and connected it to the equivalent position in the good set.



A leaky coupling capacitor between the video amplifier and the synch. separator seriously upset the latter in this circuit. A set of synch. pulses "piped" from a good set provided a simple check on the remaining circuitry.

Then I switched both sets on, set them to the same station, and waited. As soon as they warmed up the faulty set locked in without hesitation, using the horizontal pulses from the good set to operate the Synchro-Guide. There seemed little doubt that the latter portion of the set was O.K., or that this might be a useful way of checking a doubtful set in certain favourable circumstances.

TECHNICAL RELAXATION

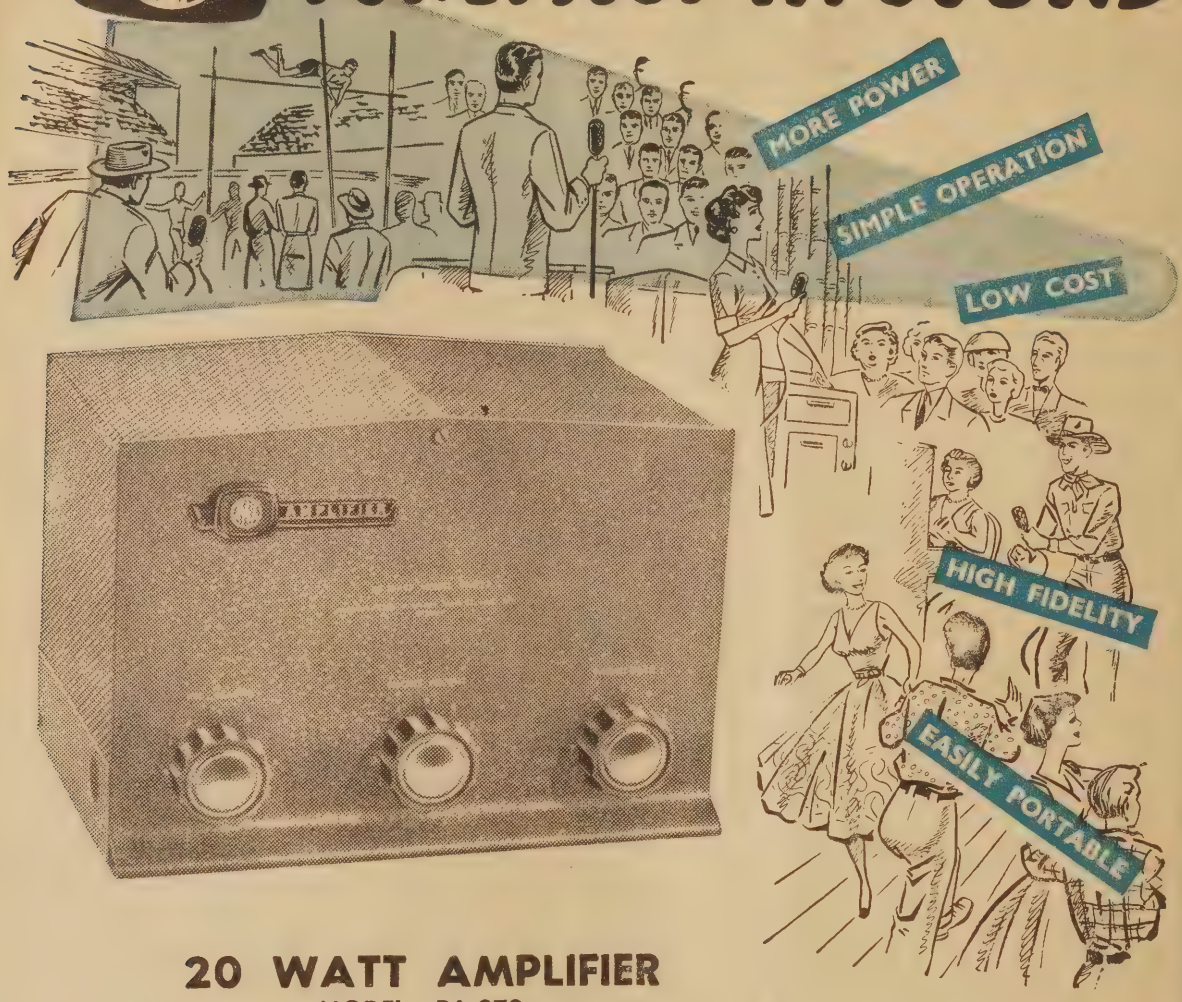
(Having set the thing up, I'm afraid I couldn't resist the temptation to tune the good set to another channel, so that a picture from channel 7 was being fed with horizontal pulses from channel 9. As I more or less expected, a series of pictures quite intact within themselves, drifted slowly across the screen at a speed indicative of the small difference in line frequencies between the two stations.

It was a weird effect, and I had a few moments fun with a colleague who happaned to drop in at that moment. Not realising the trick I had played, he racked his brains for many minutes trying to work out what kind of fault would cause such an effect. (When he finally gave up and I told him, he uttered some unprintable comments.)

But I couldn't spend all day clowning, no matter how scientific it was: I had to find why the Synchro-Guide seemed to be getting so much video with its synch.

A C.R.O. check at the plate of the first synch. separator triode confirmed the presence of the unwanted video. I also confirmed that this effect varied with the adjustment of the contrast control.

AWA FOREMOST IN SOUND



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Next a voltage check on this plate showed that it was much lower than the same point in the good set, even though the HT voltage and the plate circuit components were all intact.

This left the grid circuit, with the thought that something was upsetting the grid bias and causing excessive plate current. It took only a moment to check the grid leak and, when this proved OK, I turned to the .022 mfd coupling capacitor from the plate circuit of the video amplifier.

Checked on the R/C bridge it showed normal value, but a poor null which had to be corrected with the power factor control. Connected across the leakage terminals, it set the neon lamp glowing bright and steady, indicating a substantial leakage. Finally, I measured it on the high ohms range of the VTVM, where it measured 7.5 meg. one way round and about 6.8 meg. the other way.

I'm not quite sure why this should be so, except that the leakage obviously had some rectifying characteristic as well. I assume this may be due to the use of aluminium foil.

SIMPLE CURE

So I selected a new capacitor (a plastic dielectric type this time) checked it on the bridge, and fitted it into the set. And, of course, the oh-so-dreadful picture distortions vanished as completely as a rabbit dropped into a magician's hat.

So much for the owner's worries whether the trouble could be completely cured.

The explanation, now that I had found it, looked ridiculously simple. The leakage in the capacitor had allowed positive voltage from the video plate to reach the grid of the synch. separator, completely upsetting the operating conditions of this rather critical stage.

Normally, the synch. separator derives its bias from the synch pulses themselves which, being positive going, drive the valve into a grid current condition. This current, flowing through a high value grid leak, generates a negative bias which, other than for the strongest positive pulses, is able to bias the valve to cut-off. Being stored in the coupling capacitor, this bias remains after the synch. pulse has passed and through the video period until the next pulse arrives.

AUTOMATIC BIAS

Thus only these most positive pulses, being the synch. pulses, are able to cause any plate current flow or any signal in the plate circuit. In this way the bias adjusts itself over a wide variety of signal strengths so that it always is just the right amount.

At least that is what should happen. In this case the additional positive voltage would prevent the grid being held in its cut-off condition between pulses, allowing the video signals — or the stronger ones at least—to reach the plate circuit without difficulty.

And what happens when, instead of six or seven megs., we have 30 or 40 megs? Frankly, I'm not quite sure, but I wouldn't mind betting that some of the lesser cases of picture pulling which occur from time to time—bad enough to be mildly annoying, yet not bad enough to inspire a service call—may well be due to some such condition. Anyway, it's worth keeping in mind.

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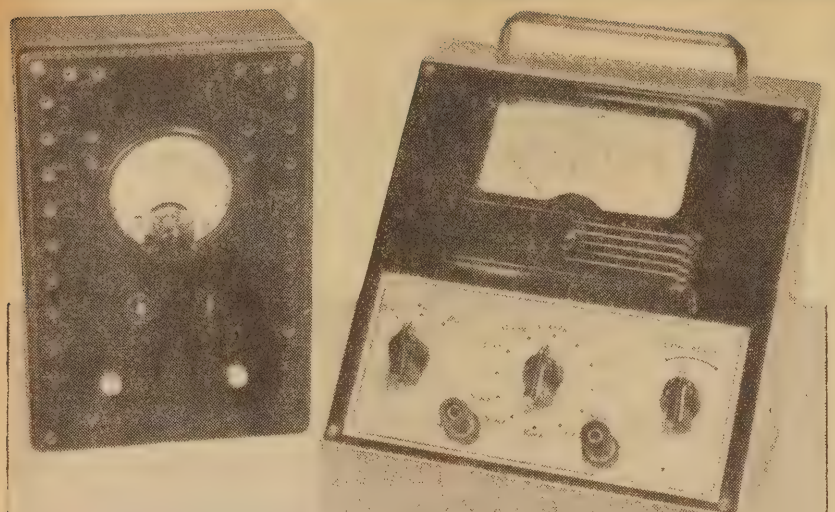


Whether your meter is one of the latest types or an "old faithful" from years gone by, the chances are that it has some significant errors if it has not been checked recently. This article deals with typical errors and their causes.

How Good Are Your Meters?

If you are beginning to doubt the accuracy of the meters you use in your everyday work and to wonder whether it is time that these were checked, the following article is designed to help you. It discusses typical multimeters, their errors, the causes, and the means of correction. It should prove a useful guide to anyone who uses meters—and that means just about everyone in the radio game.

by Philip Watson

AS in most service shops or laboratories, times recur in our own establishment when staff members commence making rude remarks about the accuracy of various meters. When this happens, and it can be shown that the comments are justified, it becomes obvious that such meters have to be overhauled and brought back to within acceptable tolerances.

TWO APPROACHES

There are two ways in which this may be done. The instrument may simply be returned to the maker with a request for a complete overhaul or, if time and facilities are available, it can be undertaken by someone on the spot.

The latter process is the one we usually adopt ourselves and, when it recently became obvious that the job had to be done again, it occurred to us that there may be something of a story in checking multimeters.

While the individual with a single meter is not in quite the same position as ourselves, we felt that he would, nevertheless, benefit a good deal from knowing how such a job may be undertaken and what are the basic causes of errors in the first place.

As far as workshops go, we imagine our set-up may be regarded as typical. We employ a number of ordinary multimeters identical with those likely to be found in any service shop. They are, in fact, the by-product of various multimeter constructional articles we have published over the years, and so the general style needs no description.

These do the hack work around the place; the run-of-the-mill fault finding and preliminary checking where a high degree of accuracy, while desirable, is not absolutely essential. They have the advantage of being simple, self contained, and capable of coping with the great majority of jobs.

For more precise work there is a group of VTVM's, including the recently described Bench Type VTVM. (This is turning out to be a serious rival to the above-mentioned conventional multimeters.) These not only provide a much higher sensitivity which is so essential in many circuits but, because their meter movements are protected from serious overload, normally hold their accuracy a good deal better.

Finally, there is one instrument which we look upon as our best available standard. It is a fairly expensive imported multimeter, well known for its all-round reliability and accuracy, and fitted with overload protection to ensure that there is little risk of someone "bashing" it during a moment of inattention.

DUAL ROLE

This unit performs two roles. It serves as a standard against which our lesser units are checked from time to time and, because it is well protected, it also does its share of routine work on the bench, whenever we need to make accurate measurements.

We imagine that most large workshops have a similar meter somewhere in the system; a kind of "working substandard" which, over the years, has come to be accepted as the final authority within the organisation. Assuming this is so, it is perfectly logical to keep the lesser meters as nearly in step with it as possible. It certainly makes for less argument if all meters read the same even if they all have the same (minor) errors!

The individual, whose sole measuring equipment is a single general purpose multimeter, is in a less fortunate position. Nevertheless, the chance to compare it with something known to be more reliable often does occur, so that there is no harm in knowing how to take advantage of the chance should it present itself.

To bring the story somewhat close to home for servicemen and hobbyists we set about to gather together as wide a variety of instruments as possible.

PERSUASION

It didn't take much arm twisting to persuade various acquaintances to submit their own personal multimeters for a free check-up, but we must admit that some of the old warriors looked as though they were due for a pension. Nevertheless, they served admirably to demonstrate just what order of error can occur—and be tolerated!

When a preliminary run through showed the most interesting specimens we labelled them with suitable identifying letters and listed their various errors in table form for direct comparison.

Quite apart from making interesting reading, a list showing the errors on a

ranges is really essential when any mete
s being checked. Quite often nothin
nore is necessary to pinpoint the main
ause of trouble and it certainly is un-
wise to start making corrections before
ll ranges have been checked and com-
pared.

Meters A, B and C were typical locally made multimeters. Meter D was an ex-disposals unit of foreign make, which had once been a very good instrument. However, around the time we started making AC readings, it developed a sticky movement and had to be put aside temporarily. Nevertheless the figures it produced are most interesting.

Meter E was one of the old warriors. It was a home-made unit built around what must have been very nearly the first meter movement and shunts ever made in this country. It had been giving little more than "token" service for many years, for very rough voltage or resistance measurements.

OLD BUT GOOD

Meter F was also very old—probably older than E—but was a high-quality imported instrument of well-known make. The figures tell a very interesting story and, after correction, this meter should have as many years work ahead of it as behind it.

Meter G was similar to A, B and C, except that it also used a very old meter movement dating back to the early days of meter manufacture in this country.

First and foremost, taking each meter in turn, it is worth commenting on what may be deduced from the list of readings. Meter A has a small negative error in the meter movement, though just within the normally acceptable limits of plus or minus 2 per cent.

The trend of this error is repeated in all the other ranges, even though it is quite small in some cases. The only serious error is on the 1,000-volt scale where an error of minus 4.5 per cent occurred at 500 volts. Theoretically nothing need be done to this meter except to correct the 1,000-volt multiplier, but few of us would be able to resist the temptation to make it a little better if possible.

LARGE ERROR

Meter B has a large basic error and this also is repeated in general terms throughout all the ranges, while meter C is similar to a lesser extent.

Meter D has a positive basic error which is repeated closely throughout the current ranges. However, and in spite of this, there are severe negative errors in the voltage ranges, suggesting that the multipliers must have increased in value quite substantially over the years.

Meter E is an even more complicated case. There is a serious basic error, positive in nature, but a number of more serious current errors in the opposite direction. Fairly obviously, the original shunts must have contained serious errors or else changed their value in some inexplicable and unlikely manner.

Meter F has a serious basic error but the almost exact repetition of this throughout the other ranges is a tribute to the accuracy of the shunts and multipliers, the latter, incidentally, being wire-wound. Fairly obviously, correction to the meter is all that is required to set things right.

Meter G has a small basic error but

WILL YOUR METER BEAT THIS ?

Standard	Meter A	Meter B	Meter C	Meter D	Meter E	Meter F	Meter G
1 mA	−2%	−6%	−4%	+2.75%	+4%	−6%	−1%
10 mA	−1%	−3.8%	−5.8%	+3%	+4%	−6%	−1.5%
50 mA	−.5%	−3%	−5.3%	+6%	−7.5%	−6.5%	−1%
250 mA	−.5%	−1.5%	−4%	+4%	−8.5%	−6.5%	+4%
DC VOLTS							
10	0	−7.8%	−4.2%	−8%	−5.5%	−6%	−5.5%
50	−1.5%	−7%	−6%	−6%	+3%	−6%	−.5%
250	−5%	−7.8%	−8.5%	−6.5%	NO RANGE	−6%	−2.5%
500	−4.5%	−6%	−8%	−7.5%	−1%	−6%	−4%
AC VOLTS							
10	0	−8%	−4%	STICKY METER MOVE-MENT	NO AC RANGES	−12%	−11%
50	−2%	−6%	−5%			−8%	−1%
250	−1%	−4%	−6%			−6%	−3%
500	−6%	−8%	−12%			−6%	−4%

If some of these errors look excessive, we can assure you that they are quite typical. Main cause of errors is overload of the meter movement, particularly where it is used on a sloping or vertical panel. Multiplier errors run a close second.

several range errors of a more serious nature. In this case, each range will have to be treated individually. In addition, there is an abnormally large error on the 10 volt AC range and this was traced to a rather interesting cause. It is worthwhile pausing to explain this.

The meter used common arcs for both AC and DC ranges; an arrangement which calls for a basic meter movement of .9 mA for the AC ranges, shunted to 1 mA for the DC ranges. The meter had this sensitivity and a suitable shunt circuit had been provided. As far as the higher AC ranges were concerned this worked out quite well.

However, on the 10-volt (or similar) range it is necessary to take into account the resistance on the "AC" side of the rectifier, and which may vary from 500 to 1000 ohms, depending on the rectifier. Therefore, arrangements have to be made to reduce the multiplier by this amount to make it suitable for the AC range, then add this amount to it for the DC range.

This had not been done in the basic design, and the owner is now working out the additional switching and circuitry required, after which the one remaining error should be eliminated.

On the other hand, the owner had conducted a very interesting experiment in regard to the rectifier proper. When the original had failed recently, he had not replaced it with a similar type, but had made up a simple bridge circuit from four type GD5 germanium rectifiers.

GOOD LINEARITY

The present check-up confirmed his earlier impression that there was no practical difference in results. In particular, we checked the linearity on the 10-volt range and found it to be excellent down to the 1-volt condition, where it read about 1.2, suggesting that it is actually more linear than the conventional meter rectifier unit.

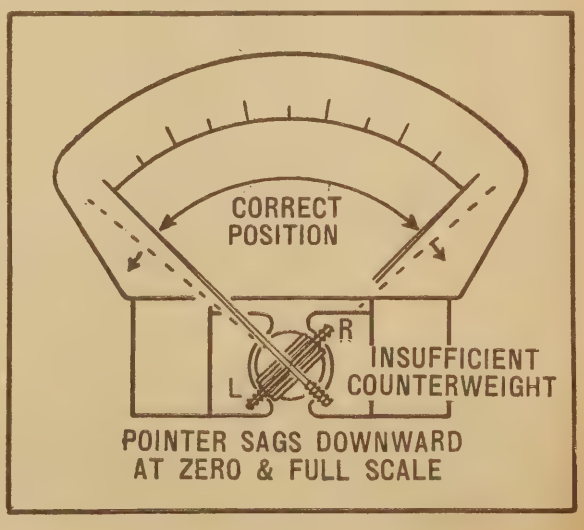
Although GD5s were used in this case, there appears to be no reason why other types might not be just as good. We tried a set of GEX35s and these came within 2 per cent at full scale and even closer at lower readings.

Our impression is that the linearity is slightly better, as with the GD5, but that the resistance on the "AC" side may

☆

A typical case of a meter with an inadequate main counterweight. An inadequate counterweight at "L" would have a similar effect at zero, but the opposite effect at full scale. The effect would vary with the mounting angle of the meter.

☆



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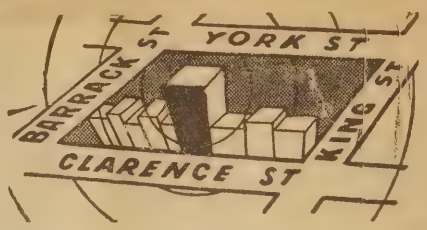

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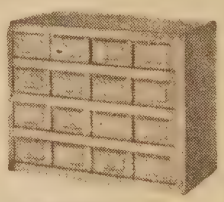

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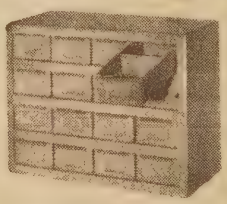

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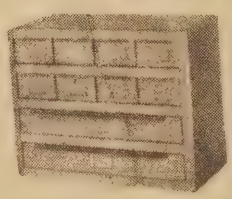

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be a few per cent higher. However, this may be an isolated case, and a conventional rectifier easily could have similar, or worse, characteristics, and still be acceptable.

Now we come to the all important question: Why do instruments lose their accuracy anyway? How much is due to the basic meter movement and how much to shunts and multipliers?

While carbon multipliers are usually No. 1 suspect in ordinary multimeters, an examination of this list actually shows that most errors are due to the meter movement, and relatively few to the multipliers.

AGED MULTIPLIERS

This may not always be so, and it is significant that many of the multipliers were either well aged resistors which had apparently been corrected on previous occasions, or modern high-stability types. The situation may not be so happy in the case of ordinary carbon multipliers, selected when new, and not corrected since. Meter "D" is a typical example.

And what of the meter movements themselves? What causes these to change? At one time, particularly in prewar years, the magnet was the weak link, and magnets had to be carefully made and well aged for this type of service.

Meter "F" is a typical example of such a magnet being affected by age. There was absolutely nothing wrong with this meter except that, being 25 or more years old, its magnet had lost a little of its sensitivity. Fortunately, it had had ample strength originally and the magnetic circuit was well shunted, so that only a minor adjustment of the magnetic shunt was needed to restore the original sensitivity.

Since the war, magnet materials have improved a great deal and the modern magnet is noted for its stability. As a source of meter failure, therefore, this is becoming more rare and we must look for other causes.

A more common fault is shorted turns in the coil, due to faulty wire insulation, faulty impregnation or just plain bad luck. If only a few turns are involved the error may be slight and within the range of adjustment of the magnetic shunt to correct it. But it can be more serious and the meter may drop its sensitivity by 50 per cent or more. Naturally, such large errors become obvious very quickly.

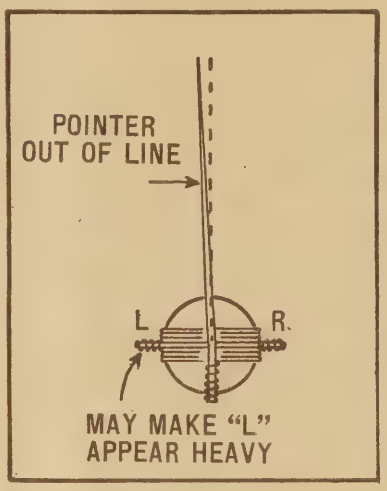
OVERLOADS

But of all the things that upset a meter's performance "bashing" is one of the most common. And it is an unfortunate fact that most multimeters take some pretty solid bashing in the ordinary run of work in service shop or lab.

To be sure, this shouldn't happen and, strictly, should be classified as carelessness, but the fact is that it does happen and, seemingly, to the most careful operator at some time. As anyone who has had the experience knows, it is all too easy to make this mistake when working under pressure or concentrating more on the problem at hand than the simple mechanics of operating the meter.

The result of such abuse may vary from a mildly bent pointer to a completely wrecked — or burnt-out — meter depending on the severity of the overload. Usually, one is lucky enough to get by with a bent pointer, sometimes so slight that it can be corrected by means of the zero shift, at other times more serious.

When this happens, most experienced workers are quite prepared to remove the front of the meter and set about straightening the pointer. Admittedly,



The usual cause of lack of balance is misalignment of the pointer. When this is bent due to overload, it may be very difficult to restore it exactly to its original position.

it is no job for anyone with the shakes and there is always the risk that the pointer may snap right off if it has to be bent too far (or too often!) but most fellows reason there is little to lose anyway and generally make a reasonable success of the job—at least on the surface.

What is not generally appreciated is the extent to which such rough and ready repairs can affect the balance of a meter, or the extent to which upsetting the balance can affect the accuracy. This applies particularly to meters mounted vertically or on sloping panel instruments.

EXAMPLE

To take a simple example, let us consider a case where a movement is merely "top heavy," i.e., the pointer tends to fall to the left at the zero end of the scale and to the right at the full-scale position. In all probability the drift to left at zero will be corrected by the mechanical zero adjustment, thus worsening the error at full scale.

Even worse, hower, is what happens at the mid-scale position where, if the zero had been left untouched, the meter probably would still read correctly, thus introducing a marked non-linearity into the system.

By the time we add a zero correction which is basically wrong anyway, a more complex condition of unbalance and a meter mounted at anything from 45 to 90 degrees from the horizontal, the ramifications of full-scale error and non-linearity assume major proportions.

Small wonder that a meter which has been bashed never seems quite the same thereafter!

There appear to be two main causes of unbalance. The balance weights may shift on their respective shafts as a result of the violent movement, or the pointer, when "straightened," may not be returned to exactly the same angle to the rest of the moving assembly which it occupied originally.

In this latter respect it may not be so much a matter of "right" or "wrong," but of how it was set originally. Practice shows that an alteration of only a few degrees can have a marked effect on balance and a setting which looks right may differ from the original in this respect.

The extent to which unbalance can affect accuracy was amply demonstrated in the case of three of the meters listed. Meter A was a horizontal type and although the oldest of the three and probably the recipient of at least as many bashings as either of the others, was by far the most accurate—as long as it was kept horizontal!

SLOPING PANEL

Meters "B" and "C" were sloping panel types and "B" had an error of minus 6 per cent and "C" of minus 4 per cent. Meter "B" was a classic example, requiring only to be re-balanced in order to regain "spot on" accuracy.

Meter "C" regained most of its lost sensitivity when re-balanced, but needed some adjustment of the magnetic shunt to complete the job. Meter "A," although quite accurate in the horizontal position, was just as much in need of balancing as the others when used at other angles.

A minimum requirement for checking balance is that the meter should be capable of being moved from the vertical through to the horizontal without any appreciable shift in pointer position, and that this be done at both zero and full-scale positions. Additional checks are provided by tilting the meter from side to side while in the vertical position.

Balancing a meter can be a tricky business and we would hesitate to recommend it to all and sundry. Much depends on the individual's skill and temperament and, as one staff member expressed it, "It's not the sort of job you tackle with a 60-watt iron and a pair of bull-nose pliers."

BALANCE ADJUSTMENTS

There normally are three balance adjustments, one directly opposite the pointer, and one each to right and left. These may take the form of small wire coils which may be pushed gently along the balance arms or, more simply, a small blob of solder deposited on the arm and decreased in size until the correct weight is obtained.

In the latter case, one of the very small, low-voltage irons, such as the Oryx, is needed to work in the restricted space without risk of damage to the meter.

However, before attacking the actual balance mechanism, it is worthwhile considering the previous statement that a very small change of pointer angle only is necessary to upset the balance. If, therefore, the meter was correctly balanced originally, and the balance weights have not shifted, it should be possible to re-balance the meter by doing no

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11. All Wave Converter 2
12. Portagram (A.C.) 4
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15. Transistor 1
16. " 2
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18. " 4
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22. Twin 5 Stereo Amp
23. Twin 10 " "
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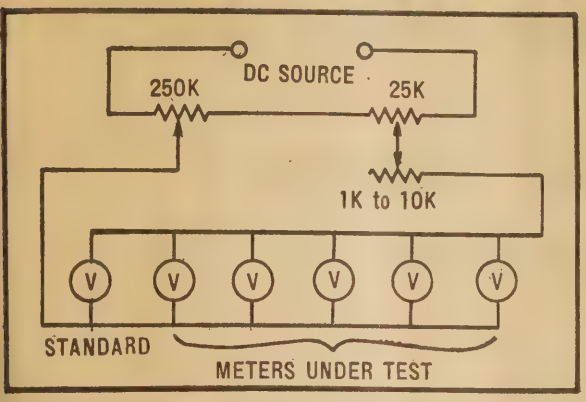
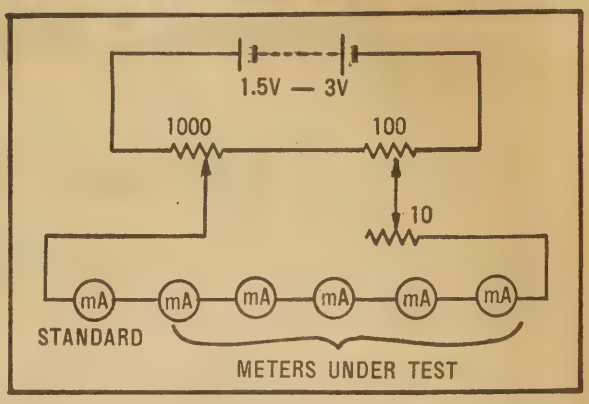




Circuits such as those above may be used to supply and control voltage and current for the standard meter and the meters under test. A variety of voltage sources may be used, including batteries, radio and TV sets. Care must be taken that any potentiometers selected are able to dissipate the power involved.

nore than patiently adjusting the pointer ngle a little at a time.

In fact, this proved to be so in at least wo of the meters listed. In other cases, nd for various reasons, there were loubts about the setting of the balance veights, and the whole balancing proce- lure had to be undertaken from scratch.

If the balance weights have to be ackled, try to work out the most likely ause of the error first and the nature f the correction which should be at- empted. In one case it was found neces- ary to completely remove both side veights (blobs of solder) before any ense could be made of the main pointer ounter-balance. When this was cor- ected, only minor corrections to the ide weights proved to be necessary.

Assuming that the meter is correctly alanced, any remaining error may be orrected by means of the magnetic hunt. This takes the form of a small ectangle of soft iron, slotted to take a olding screw, and fitted across the gap etween the two pole pieces. The mount of shunt across the gap, or even ts angle, provides an easy method of djusting the meter sensitivity and most neters have a reserve of magnet strength o allow for possible ageing effects.

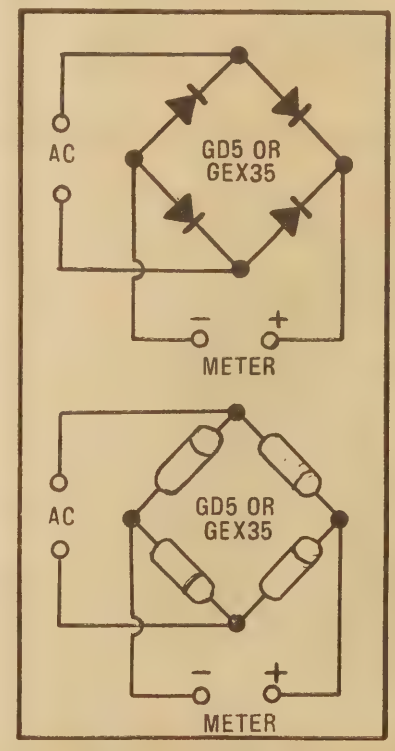
Adjusting the shunt is not difficult, ut the entire movement probably will ave to be removed from the case. Par- icular care should be taken to see that o magnetic dust can be collected by he magnet and find its way into the gap. lean the bench area to be used first, nd spread a sheet of clean paper over before opening the meter. Also take are that screwdrivers do not introduce rticles by reason of their becoming agnetised.

Finally, if you feel less than equal to ese tasks, it would be far better to send e movement back to the makers with structions that it be re-balanced and re- alibrated. With a fully reconditioned ovement to work with, you may then roceed with the rest of the job.

This is the adjustment of individual unts and multipliers. Shunts, being ire wound, normally do not shift ap- reciably with time but, nevertheless, ere are times when these may benefit om minor adjustments, at least.

If the range reads high, it means that the shunt resistance is high and can stand additional shunting. Ordinary half-watt carbon resistors are perfectly satisfactory, and there is no worry about drift when used in this application. It is handy to remember that a resistor 100 times greater than the nominal shunt value will reduce it by approximately 1 per cent.

Where the shunt appears to be low in value, adjustment is not quite so easy. If the error is small it may have to be tolerated, otherwise a new shunt fitted or even wound.



Circuit showing how type GD5 or GEX35 germanium diodes may be used to replace the conventional instrument rectifier. Sensitivity and linearity appear to be well within accepted tolerances.

In all the above operations it should be appreciated that the application of heat to the junction of dissimilar metals can generate quite substantial voltages; enough to shift the meter zero by several divisions in some cases. Such joints must be cooled before any accurate tests can be made. Methylated spirit is a useful liquid for cooling.

Remember also that heat applied to ordinary carbon resistors can alter their resistance, usually permanently and usually in an upward direction. Care should therefore be exercised when soldering to their pigtails.

Carbon multipliers also tend to drift high in value with age, causing the meter to read low. Once again the fitting of parallel resistors is an easy solution, but one may occasionally have to fit a series resistor where a multiplier appears to be low for some reason. This is not quite so easy, the main problem being the physical one of finding a place to put it and a means to support it.

As with the shunts, ordinary half-watt carbon resistors are perfectly satisfactory and, in case this should appear to contradict the whole idea of the undertaking, a few words may not be out of place.

The added resistance, whether it be in series or parallel, represents only a small fraction of the total resistance in the circuit, say, 10 per cent at the most. Therefore, a shift within this portion of, say, 10 per cent will affect the total by approximately 1 per cent.

NEW OR OLD

This also raises the question as to whether old multipliers should be retained and "doctored," or thrown out and new ones fitted. If it is intended to fit the best high stability types, there is probably very little to it except the cost, and a full set of high stability multipliers can be quite expensive.

However, there is nothing to be gained by throwing out old resistors and replacing them with the same type. In fact, the old resistors are far more valuable, having aged to the point where they probably will remain reasonably stable for the rest of their life.

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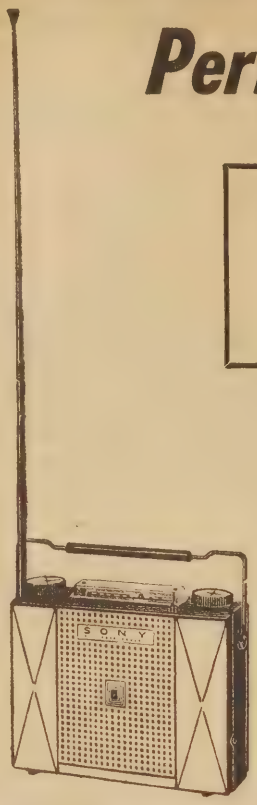

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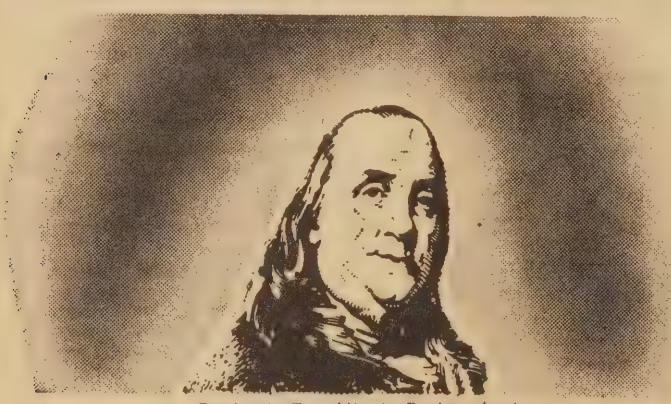

Benjamin Franklin (a Rosicrucian)

Why was this man great? How does any one—man or woman—achieve greatness Is it not by mastery of the powers withi ourselves?
Know the mysterious world within you Attune yourself to the wisdom of the ages Grasp the inner power of your mind Learn the secrets of a full and peaceful life! Benjamin Franklin—like many othe learned and great men and women—was Rosicrucian. The Rosicrucians (NOT religious organisation) first came t America in 1694. To-day, headquarters o the Rosicrucians send over seven millio pieces of mail annually to all parts of th world.

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y present a few minor problems, and following suggestions may be help-

For current checks the meters to be npared are connected in series, taking e to see that each is adjusted to the rect range. A small battery, such as .5 or 3-volt dry type, or a 2-volt ac-nulator, will be a suitable source of wer, and it only remains to provide ans to control this smoothly on all ges.

ordinary power transformer will supply most of the voltage required and the same control pots. may be used. Two filament windings in series will cover up to 10 volts, one half of a 285 secondary will serve for the 50 and 250 volt ranges, while the total secondary will provide at least a half scale reading on the 1,000 volt range.

In general, the A.C. ranges will follow the trend of the D.C. ranges, since only the rectifier has been added. However,

A VACANCY ON OUR TECHNICAL STAFF

We have an immediate vacancy on the staff of "Radio, Television and Hobbies" for a radio engineer or an experienced techni ian capable of originating, constructing and describing the class of project regularly featured in these columns.

Academic qualifications and the A.O.C.P. are an advantage but not essential for the position. More than anything, we are keen to find someone who has had experience in the varied fields of audio, radio and television and transmission and who wants to extend and capitalise upon it as a te hnical journalist.

Applicants should be resident in Sydney and free to begin duties within one month of appointment and preferably not later than November 1, 1959.

Applications should be made, in the first instance, by letter only, giving details of experience, copies of references and stating the order of salary required. Letters should be addressed to The Technical Editor, "Radio, Television and Hobbies," Box 2728C G.P.O., Sydney.

All correspondence will be treated with the strictest confidence.

Upon appointment and subject to satisfaction and medical examination, the successful applicant will be eligible for four weeks annual leave, Accident and Sickness benefits and Superannuation.

In some cases a simple variable re-tor, as provided by a low value wire-ound pot. may be sufficient, much de-nding on the ranges involved, the total istance provided by the meters and e voltage of the battery.

A better arrangement uses two pots. nnected in series and with the outer minals connected to the voltage source. e value of one pot. should be from e to 10 times that of the other to give "coarse" and "fine" control. The series ter circuit connects between the two oving arms. If desired a third pot., nctioning as a simple variable resistor, ay be connected in series with one ter lead. If this is very low in value, it rves as an extra "fine" control. Typical lues could be 1,000, 100, and 10 ohms.

For voltage checks all meters are con-cted in parallel, and suitable sources of C. and A.C. voltage must be provided. provide fine adjustment a set-up nilar to that described for current con-l is used, except that higher value pots. ust be used to avoid excessive dissipa-n. In this respect, the normal ratings e two watts for wire wound and 1 watt large carbon types, spread over the ole element.

OLTAGE SOURCES

For the actual voltage sources there e a number of possibilities. Up to 10 lts, dry batteries are often most con-nient while a 90 volt battery, even a carded one, can often be used for the volt range.

An ordinary receiver is a good source r the 250 volt range, but the 1,000 volt nge may present a problem. We settled r a half scale adjustment on this occas-n, using voltage from the B-plus boost cuit of the current TV set. Actually, arly 700 volts are available here if e load is light.

The A.C. ranges are even simpler. An ordinary power transformer will supply most of the voltage required and the same control pots. may be used. Two filament windings in series will cover up to 10 volts, one half of a 285 secondary will serve for the 50 and 250 volt ranges, while the total secondary will provide at least a half scale reading on the 1,000 volt range.

In general, the A.C. ranges will follow the trend of the D.C. ranges, since only the rectifier has been added. However, the tolerance on rectifiers is broader, being plus or minus 5 per cent. If this figure is exceeded there is little that can be done except to change the rectifier.

Rectifiers normally exhibit two common faults. One is a failure of one section of the bridge which drops the reading to about half what it should be. It is so obvious as to require no further comment. The other may be an increase in resistance on the "A.C." side of the bridge which, being in series with the multipliers, will cause the A.C. ranges to read slightly low. Normally it would have little effect above the 10 volt range.

DOWN ON ONE RANGE

Meter "F" showed this characteristic, being about 6.5 per cent down on the 10 volt range, but well within tolerance on higher ranges. A new rectifier, if one can be obtained, probably will be fitted when time permits.

Just how closely you try to match your meter against the standard will depend mainly on your time and patience. If you have enough of both you can adjust your meter to be "spot on" for every range, but this can take a lot of time. Alternatively, you may be content to work to the normal 2 per cent tolerance, and this certainly makes things a good deal easier.

It will be all you will get anyway if the job is done professionally, unless you pay a good deal more for it.

In adjusting the specimen meters, we struck a compromise, electing to try for something better than the normal 2 per cent, yet not being so finicking as to waste a lot of time over a fractional percentage error.

The result is a batch of meters which should have considerably better than normal tolerance.

That is, until their owners bash them again!

MONTHLY NEWS LETTER

News which we think will be of particular interest to all enthusiasts is that we have now installed two-way radio in some of our vehicles to enable these cars to give Hi-Fidelity Sound equipment service in your own home, anywhere in the Melbourne metropolitan area. This service covers not only Hi-Fi and Stereo equipment, but standard radiograms, amateur gear, home cinema equipment, projectors, tape recorders, etc. Everything from replacing your styli or repolishing your cabinet to a complete overhaul will be undertaken and we think you will agree that this is quite a comprehensive service. We are happy to announce that Mr J. Seefer, who is a specialist in sound and projection equipment, has just joined our staff and is directing this department.

This month we have a special available—Imported Dutch Philips Hi-Fi Record Changer Single Players, complete with diamond styli, plug-in Hi-Fi head, standard head and stereo head, mounted in a polished wooden table top cabinet, for £28/10/, boxed and packed. Usual price, £56. Limited quantity available, one per customer. Mail orders invited.

We have another large shipment of imported stereo records available and consider that the comprehensive selection is well worth a visit to our showrooms for anyone who is interested in hearing the magnificent discs now released. Our clients have expressed themselves very happy with the results of our record cleaning service and as it is still available, we hope you will take this opportunity of having your records cleaned and treated on the Parastat machine. We have also had many congratulatory remarks on the "Neat" range of turntables, pickups and arms and our only hope is that we can keep up supplies to meet the high demand. We would also refer you to our advertisement in this issue of other Hi-Fi lines, photographed. Until next month, then, we remain,

Yours,

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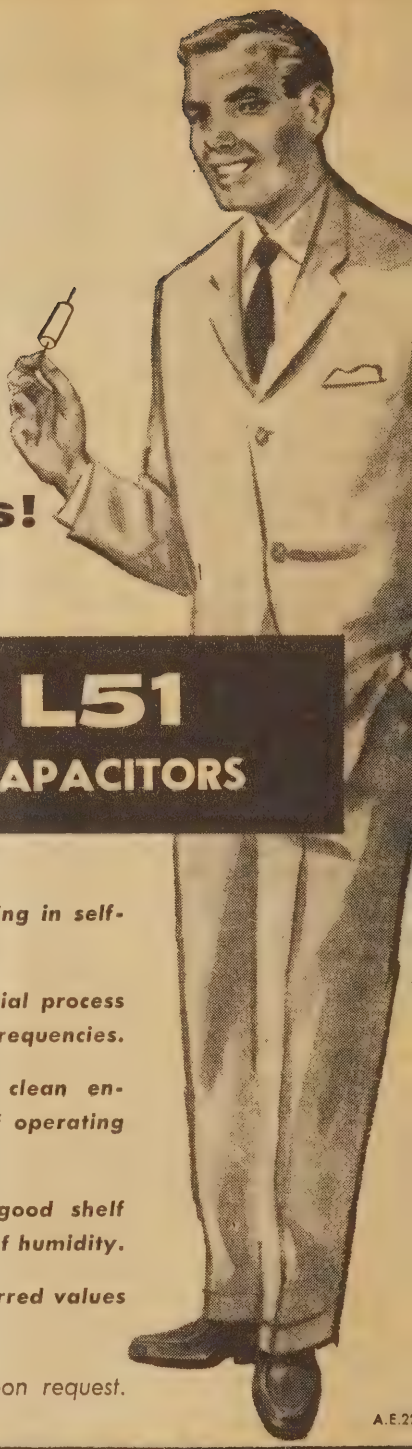

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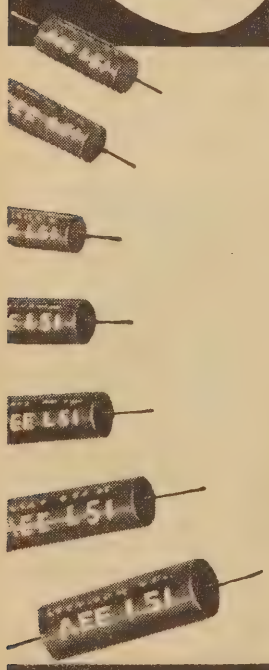

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HOW TO GET YOUR AMATEUR LICENCE

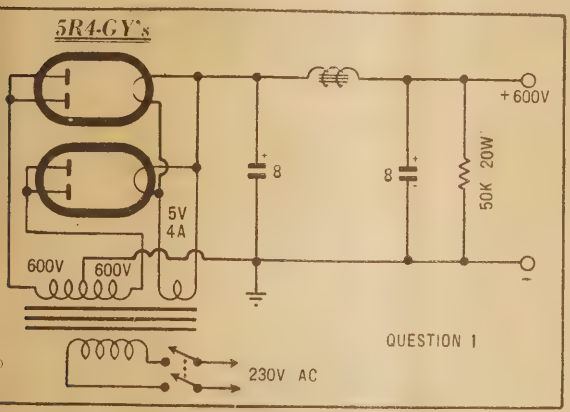
For the assistance of those who are studying to gain the Amateur Operator's Certificate of Proficiency, here are some answers to the technical paper set for the examination of July, 1958, which we think would gain high marks. The time limit for the paper is 2½ hours, and only seven questions were to be attempted.

UESTION 1:

Sketch a schematic circuit diagram of a full-wave rectifier system capable of supplying high-tension voltages of the order of 600 volts at 200 milliamperes D.C. from 230 volt 50 c.p.s. A.C. mains.

What safety and other precautions should be taken in the construction of such a rectifier system when using (i) block type and (ii) electrolytic type filter condensers?

Answer: Herewith circuit of power pply required. As there are no full- ave rectifiers capable of withstanding



e voltage and current specified, two 4GY rectifiers are used with parallel ates to increase the total rating. With these rectifiers, and in the ab- ce of valve curves, approximately 600 lts D.C. will be obtained on load from transformer rated at 600 volts A.C. ch side of centre tap. The capacitor nnected to the rectifier filaments ould have a D.C. voltage rating of at st 840 volts.

(i) When using block capacitors in a wer supply, it is essential to provide bleed resistor across the output so at, in the event of the supply being itched off without load, the capacitors l be rapidly discharged through the istor. Otherwise they may retain a arge for long periods and supply a ngerous electric shock on contact with supply output.

(ii) As the supply voltage exceeds the ings of a single electrolytic capacitor. o or more may be connected in series increase the voltage rating, although total capacitance will be reduced in portion to the number used. The pacitors in series should all be of the ne type, and resistors should be con- cted in parallel with each to form a tage divider which will help to equalise voltage drop across them. The D.C. istance of electrolytics may vary over de limits, and those with the highest istance will otherwise run risk of damage, as they will carry the highest proportion of the voltage drop across the chain. A failure in one such capacitor may cause the whole chain to fail.

★ ★ ★

QUESTION 2:

Sketch the basic schematic circuit diagram of a superheterodyne receiver, and explain the fundamental differences between it and the tuned radio frequency type.

What advantages does the superheterodyne receiver possess in comparison with the latter type for communication purposes?

Answer: A tuned radio frequency receiver amplifies and detects signals at the frequency to which it is tuned. A superheterodyne receiver, in addition to any amplification at the signal frequency which it may provide, uses a converter stage which mixes the incoming signal with that provided from a local oscillator, so that the heterodyne present in the converter output circuit is always at a predetermined intermediate frequency. The major amplification takes place at this intermediate frequency by means of amplifier stages, usually interconnected by transformers tuned to the intermediate frequency.

The main advantages of the superheterodyne are:

1. Higher amplification due to the more efficient circuits of the intermediate amplifiers which invariably operate at a frequency lower than that of the signal frequency.

2. Higher selectivity due to a larger number of resonant circuits, their higher Q, and the fact that the IF is lower than the signal frequency.

3. Much simpler and effective AVC circuits.

★ ★ ★

QUESTION 3:

With the aid of sketches, describe the construction and theory of operation of a type of microphone

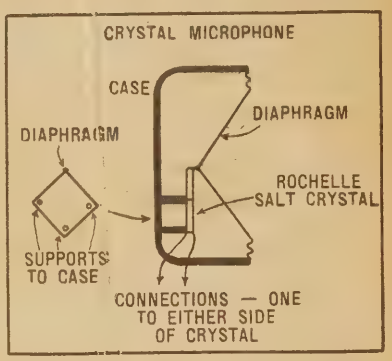
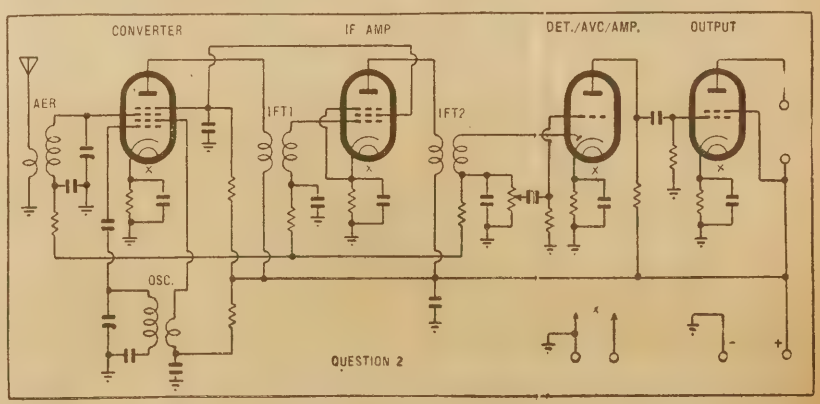


Diagram of a crystal microphone asked for in Qustion 3.

suitable for use in an amateur station.

Show how the microphone you have described may be connected to an audio amplifier.

Answer: Crystal microphones are widely used in amateur service. A thin diaphragm, usually conical in shape, is clamped at its apex to one corner of a slab of Rochelle salt crystal, the other corners being fixed firmly to the case. Energised by sound, the diaphragm transmits vibrations to the crystal. When subject to such physical movement, the crystal has the property of generating potential differences between its large faces. These are coated with some metal-

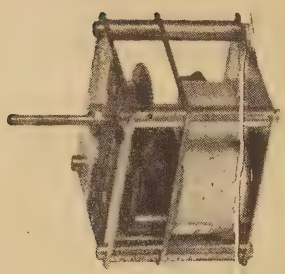


MIGHTY MINIATURE

"PAYNECO"

SYNCHRONOUS

MOTORS



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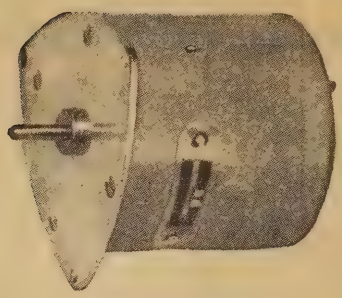

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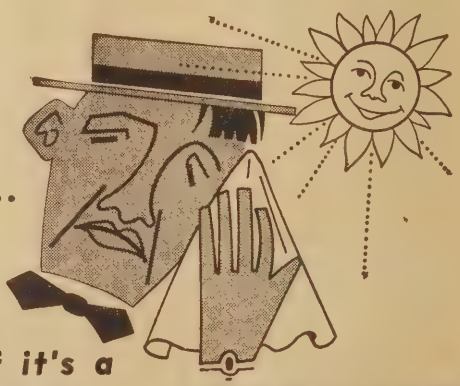

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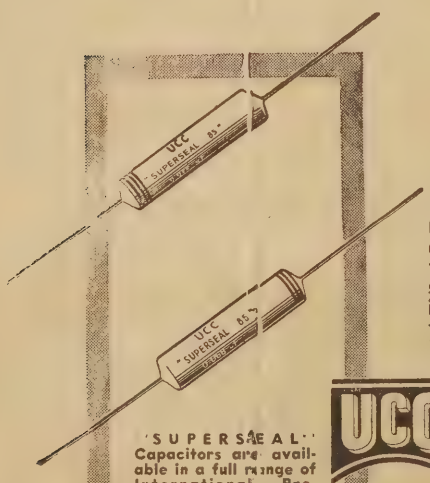

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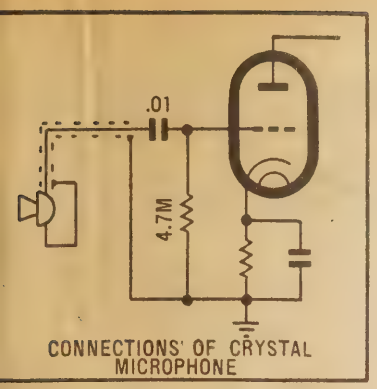


CONNECTIONS OF CRYSTAL MICROPHONE

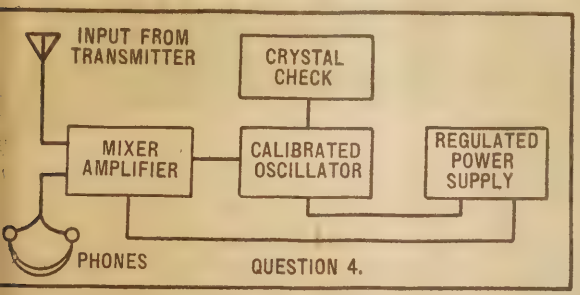
c material to which output leads are ttached. The potentials generated by he crystal are used to energise audio mplifiers which in turn operate the iodulator.

Such a microphone operates as a vari- ble capacitor and requires a high im- edance load, usually about 5 megohms. t is therefore suitable for direct con- ection into the grid circuit of a valve mplifier.

★ ★ ★

QUESTION 4:

When employing a 3.5 Mc/s crystal describe how to determine that the radiated emissions from a three-stage transmitter are on 7 Mc/s and not on 3.5, 10.5 or 14 Mc/s.



QUESTION 4.

(b) Draw a block schematic diagram of a frequency measuring system suitable for measuring an emission in the 7 Mc/s band with reasonable accuracy.

Answer—(a) When adjusting a three- tage transmitter it is important to make ure that the tank circuit of the inter- iediate stage is not tuned to either 10.5 r 14 Mc, the third and fourth har- ionics. If it is, it will be impossible o resonate the final tank circuit to 7 Ic.

The best method of tuning the tank ircuits to the correct operating frequen- ies is by using a grid dip oscillator.

This consists of a calibrated oscilla- or, the tuning coil of which may be oupled to external circuits such as the ransmitter tank coils, so that these may bsorb power from the oscillator coil.

A meter is connected in the grid cir- uit of the oscillator to indicate the rid current. When the oscillator coupled to the tank coil being checked, he meter will show a deflection or a ip in its reading as the tank coil is uned to the same frequency. If the oupling is reduced until the observed ip is very slight, an accurate adjust- ient can be made. If the tank circuits re tuned to an undesired harmonic of ie crystal, they will not operate the rid dip meter if it is tuned to 7 Mc.

If a pair of phones is connected in the late circuit of the grid dip oscillator, so that it will detect a beat note between the oscillator and the output of the transmitter, it can be used to check the operating frequency.

Such a circuit, built into a stable and shielded physical form, becomes a heterodyne frequency meter, and can be calibrated with great accuracy. Because it will provide a beat note on both its fundamental and harmonics, it is best to establish the order of multiplication with a grid dip oscillator before making an accurate reading with the frequency meter.

(b) The units in the block are generally contained in a single case. The crystal oscillator is of high stability and, mixed with the output of the oscillator, provides beats throughout its range for checking calibration from time to time.

★ ★ ★

QUESTION 5:

An E.M.F. of 1,600 volts D.C. is applied to a resistance of 50 ohms connected in series with two resistors of 600 ohms and 200 ohms in parallel.

Calculate:

(i) the current flowing through the 50 ohms resistor;

(ii) the power dissipated in the 600 ohms resistor.

Answer—The effective resistance of the paralleled resistors is found by multiplying their values and dividing the answer by the sum of their values. This equals 120,000 divided by 800 or 150 ohms. The total resistance across the 1600 volts is therefore 50 plus 150 or 200 ohms.

(i) The current drawn from the supply is equal to 1600 divided by 200 or 8 amps. This is the current which flows through the 50 ohm resistor.

(ii) Because the total current in the circuit is 8 amps, by Ohm's Law the drop across the 50 ohms will be 400 volts, and the drop across the paralleled resistors 1200 volts. The power dissipated in the 600 ohms resistor will therefore be equal to 1200 x 1200 divided by 600 or 2400 watts approx.

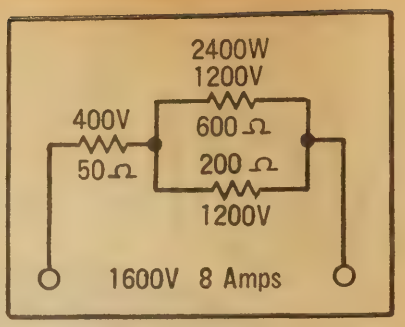
★ ★ ★

QUESTION 6:

With the aid of sketches, describe the construction and operation of a moving coil meter having an internal resistance of 100 ohms and a full-scale deflection of one milliampere. Calculate how the instrument may be adapted to give a fullscale reading of (i) 100 milliamperes, (ii) 100 volts.

Answer—A moving coil meter consists of a small coil of fine wire wound on a former to which a pointer is attached. The coil is suspended between needle points so that it can rotate in a magnetic field through an arc of about 90 degrees. A central pole piece mounted inside the coil provides that the coil moves within a gap in the field across which is concentrated the magnetic flux of the circuit.

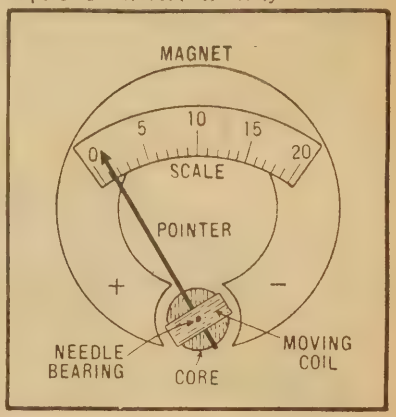
When a current is passed through the coil of wire, a magnetic field is set up around the coil which interacts with that of the fixed magnet, and if the coil is suitably orientated when at rest, it will rotate, moving the pointer with it.



Question 5. Diagram (optional) purely to clarify the question and answer.

A pair of hair springs is included to check the movement of the pointer and to return it to its reference point when the current is removed. When correctly adjusted, the movement of the pointer is directly proportional to the current flowing through the coil, and is substantially linear over its arc of deflection.

If the meter is required to measure 100 milliamperes, and requires 1 milliampere of current to fully deflect it.

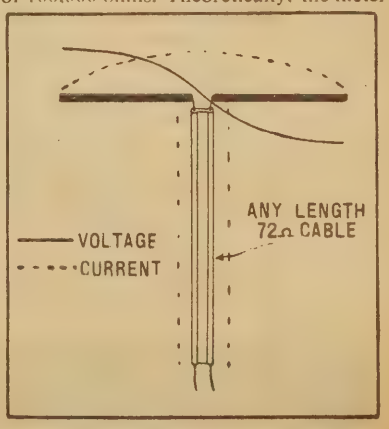


then an external shunt must be fitted.

The value of this shunt will be equal to the resistance of the meter divided by the multiplication factor minus 1. This equals 100 divided by 99, or 1.01 ohms.

For the meter to read 100 volts, a resistor must be placed in series with it so that, when connected across 100 volts, 1 milliampere will flow through the resistor and the meter.

By Ohm's Law this requires a total of 100,000 ohms. Theoretically, the meter



Aerial for 14MC asked for in Question 8. Dotted line shows current distribution, solid line voltage distribution.

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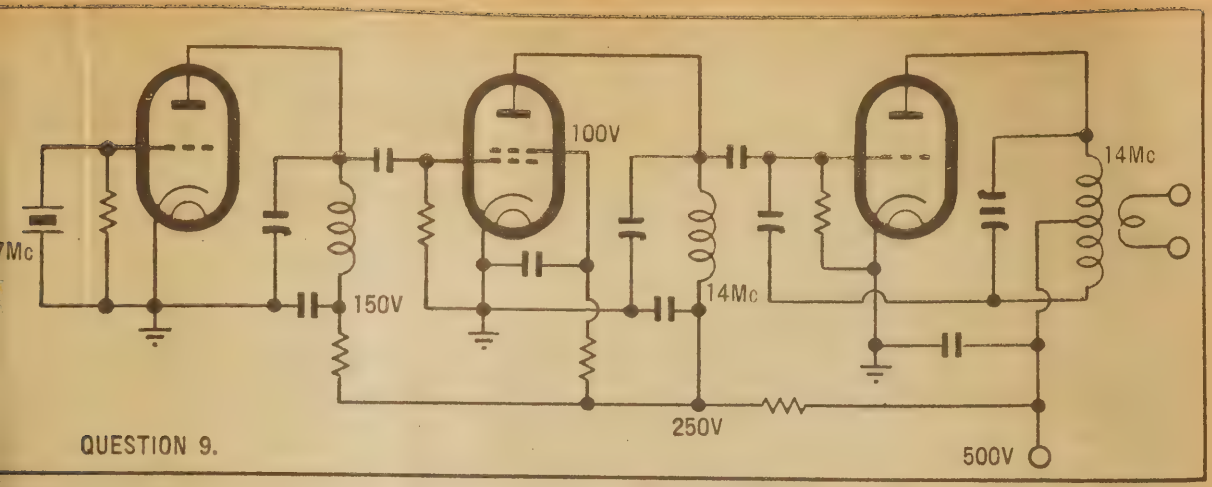

QUESTION 9.

esistance should be subtracted from this, ut is so small a percentage on this ange that it may be ignored.

★ ★ ★

UESTION 7:

What are the fundamental differences between frequency modulation and amplitude modulation? List the advantages and disadvantages of each system.

Answer: In amplitude modulation, the gnal is impressed upon the carrier in ich a way that its amplitude varies with e intensity of the modulating signal, id at a rate depending on its frequency. In frequency modulation the signal is mpressed upon the carrier in such a ay that its frequency varies around a ntre by an amount depending on the mplitude of the modulating signal, and a rate depending on its frequency.

In amplitude modulation it is usual to odulate the final amplifier in its plate rcuit. This calls for an audio ampli- r and modulator which will supply ithout distortion a power output equal half the value of the RF power in- ut to the final stage.

In frequency modulation the modula- r operates at or near the oscillator age where very little power is needed, id the modulator is therefore less cost-

Because of the wider bandwith needed, M services invariably must operate on HF. AM can be used on all frequen- es.

Advantages of AM are:

Transmitter circuits are relatively mple and not difficult to adjust.

Receivers are much simpler than for M and less costly. They are easier to ep in alignment, and the effects of all misadjustments are not often seri- us.

Disadvantages of AM are:

Transmitters are large and costly. inal RF stages must be operated at less an maximum ratings to accommodate e peak voltages and currents demand- l by the modulators.

Receivers are sensitive to atmospheric id electrical interference which cannot ways be efficiently suppressed.

Advantages of FM are:

Transmitters are not so costly because the low-powered modulators used. The nal RF amplifiers may be operated at ll ratings because the carrier power not altered during modulation.

Good rejection of atmospheric and ectrical interference is possible, and this akes high sensitivity practicable.

Disadvantages of FM are:

Transmitters are more difficult to adjust and maintain in balance and alignment.

Receivers are more complicated and costly than for AM. They require more stages to amplify and limit the signals, and the design of discriminator stages which resolve the signal is more difficult than for the diodes used in AM. Alignment is quite critical. The effects of drift and misalignment can cause serious distortion and rapid deterioration of performance. Power supply regulation can be critical. Further complication arises from the need to operate at VHF, which generally calls for more amplifying stages.

★ ★ ★

QUESTION 8:

Show schematically a type of aerial suitable for radiation within the 14 Mc/s amateur band and describe in detail an efficient means of coupling the aerial to the transmitter. Explain briefly the technical reasons for your choice of aerial and transmission line.

Answer: The diagram shows a half-wave aerial for 14 Mc fed at the centre by a length of 72 ohm balanced cable.

The impedance at the centre of a half-wave antenna in free space is approximately 72 ohms, and this is taken as a working figure for such aerials of reasonable height, preferably greater than one half-wave length.

Because this point is resistive it is practicable to connect to it a balanced cable with a characteristic impedance of 72 ohms and of any length. It will be matched to the aerial and impose a 72 ohm resistive load upon the transmitter to which it is coupled.

The characteristics of this type of aerial are that maximum radiation takes place at the centre and right angles to its length. A sharp null point appears along a line parallel to the aerial and passing through it.

The aerial may be coupled to a transmitter by means of a coupling coil of small dimensions connected to the end of the line. Its number of turns should be such that, when related to the number of turns in the tank coil and the degree of coupling, it forms the secondary of an impedance transformer which matches 72 ohms to the impedance required by final tank circuit.

A small series capacitor may be inserted at one end of the loop to cancel out the inductive reactance of the coupling coil.

The aerial mentioned has the merit of absolute simplicity. By adding a further half-wave to one side it becomes a full-wave antenna fed one-quarter-wave length from the end and now exhibits a clover-leaf field pattern which would be more useful for general coverage.

The method of feed is simple and efficient. Properly matched, there is virtually no radiation from the line to cause losses and possible feedback by introduction into the audio system. The cable is light and non-critical in placement. It requires no aerial tuning networks and is particularly suitable for single band work. Its coupling coil can be easily shielded for harmonic suppression.

★ ★ ★

QUESTION 9:

(a) Draw a schematic circuit diagram of a three-stage crystal controlled transmitter using a triode valve in the final stage which is to function as a straight amplifier. Points of power supply connection with appropriate voltages only need be shown.

(d) Describe, step by step, how you would proceed to neutralise the final stage. Explain fully why this action would be necessary.

Answer: (a) The transmitter shown commences with a crystal oscillator operating in the 7 Mc band. Comparatively low voltage is used in the interests of stability and because the amount of drive required for the following pentode is quite low.

The pentode operates as a frequency doubler to 14 Mc. There is no need to neutralise this stage because it is a pentode and because its input and output circuits are tuned to different frequencies.

The final stage, a triode, is neutralised to avoid oscillation through feedback via its grid to plate capacitance, and a small valve of this type should be driven adequately from a suitable pentode with voltages of the order of those shown.

To neutralise the final stage a meter is introduced in series with the low potential end of the final grid resistor. High tension is applied to the first two stages, but not to the final, under which conditions the meter will read the rectified grid current of the final stage.

As the final tank capacitor is tuned through resonance the meter will register a change in grid current unless the stage happens to be neutralised. The neutralising capacitor setting is varied until there is no movement of the grid current as

(Continued on Page 120)

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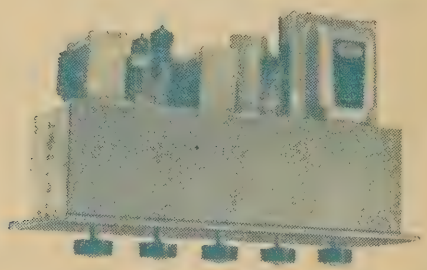

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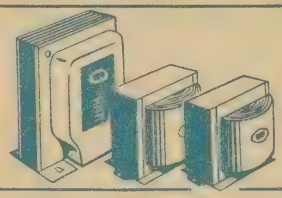

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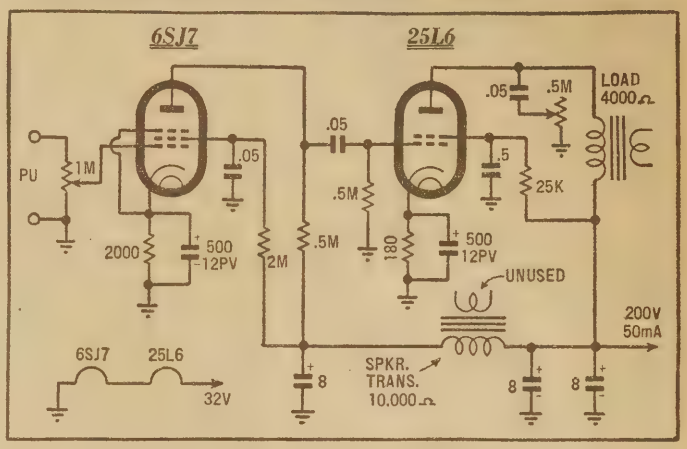
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

AMPLIFIER OPERATED FROM 32V SUPPLY

Some ideas on an amplifier to operate from a 32 volt supply are contributed by Mr P. Lukins of Oxley via Wangaratta, Vic. It may help some of our younger readers in the country, to acquire an amplifier from parts often to be found in the "junk box".



UMMARISING Mr Lukins' letter: The circuit works from 32 volts ıd gives just under four watts output. ıe total current drain for the vibrator ıx and filaments is only 0.8 amps, and e high tension between 180 and 200 lts. Additional filtering in the form a speaker transformer primary in the gh tension supply to the 6SJ7 cuts out e last trace of hum. The original was signed to reflect 10,000 ohms, but her transformers would probably serve ually well. The secondary winding is t disconnected.

The output valve should operate into load of 4,000 ohms and the speaker ınsformer should be designed to reflect i value from the voice coil of the rticular speaker chosen.

Overall gain of the amplifier is quite gh, and input and output circuits ould be well separated. Particularly the pickup terminal should not be placed too close to the output valve. The leads from the pickup terminal to the volume control and from the volume control to the grid pin of the valve should be kept short and tucked well down to the chassis. It should be kept well away from the plate wiring of the same valve and obviously the plate wiring of the 25L.

The amplifier can be overloaded with the output from a HGP-37 cartridge on microgroove and the sensitivity for full output would be put at about 0.1 volt.

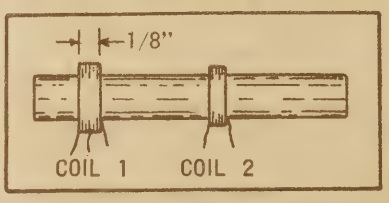
Negative feedback and bass boost can also be added to the amplifier. The feedback is provided by a 1 meg resistor connected between the plates of the two valves. A .0012 uF capacitor is connected in series with this resistor to provide bass boost. A switch could be added to short the capacitor out when the bass boost is not required.

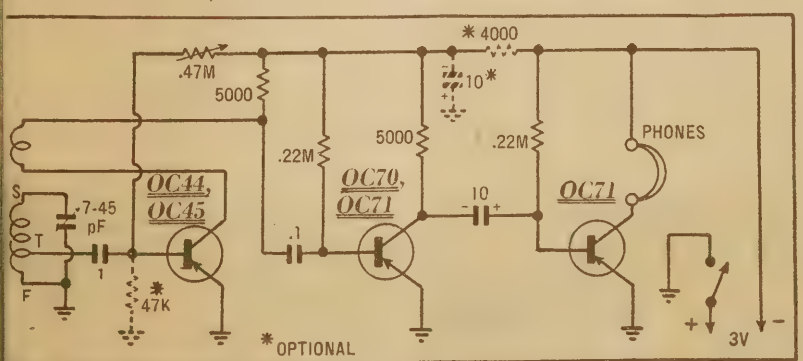
For the power supply I used a commercial unit with an output of 200 volts at 50 mA drain. A very cheap and reliable supply for the amplifier could be made with one of the disposals genemotors rated at 28 volts input and about 230 volts output. A heavy duty low resistance dropping resistor in the primary circuit would be needed to keep the output voltage down to the 200 volt maximum.

(A larger capacitor than the 0.5 uF as a screen bypass for the 25L6 may be desirable in order to improve the bass response. We would suggest an 8 uF electrolytic. The amplifier could be operated with a 110-volt supply when the screen could be connected directly to the supply without a dropping resistor. The plate load resistor should then be about 2,000 ohms and the cathode bias resistor 150 ohms. Power output under these conditions will be about 2 watts. Ed.)

REGENERATIVE CIRCUIT FOR POCKET RADIO

A simple regenerative receiver design which can be built up in a few minutes is shown in the circuit below. It tunes only a limited frequency range but the absence of a full size tuning capacitor makes very compact construction possible.





THE reader we have to thank for the idea is Mr D. Haskard of No. 3 Le Anau Avenue, Prospect, S.A., who says: "I am sending you a copy of a transistor regenerative set which requires no aerial for local stations. The signal is clear and the set has plenty of volume. Tuning is by a trimmer approx. 7-45 pF which covers from about 700 Kc to 1400 Kc and enables the five Adelaide stations to be received clearly.

"The regeneration can be varied by sliding the regeneration coil along the rod or by varying the 470 K resistance.

"An optional decoupling circuit is shown. It may be needed to prevent oscillation.

"The aerial coil (1) consists of 105 turns of 38 SWG enam. wire tapped at

(Continued on Page 120)

PART TWO

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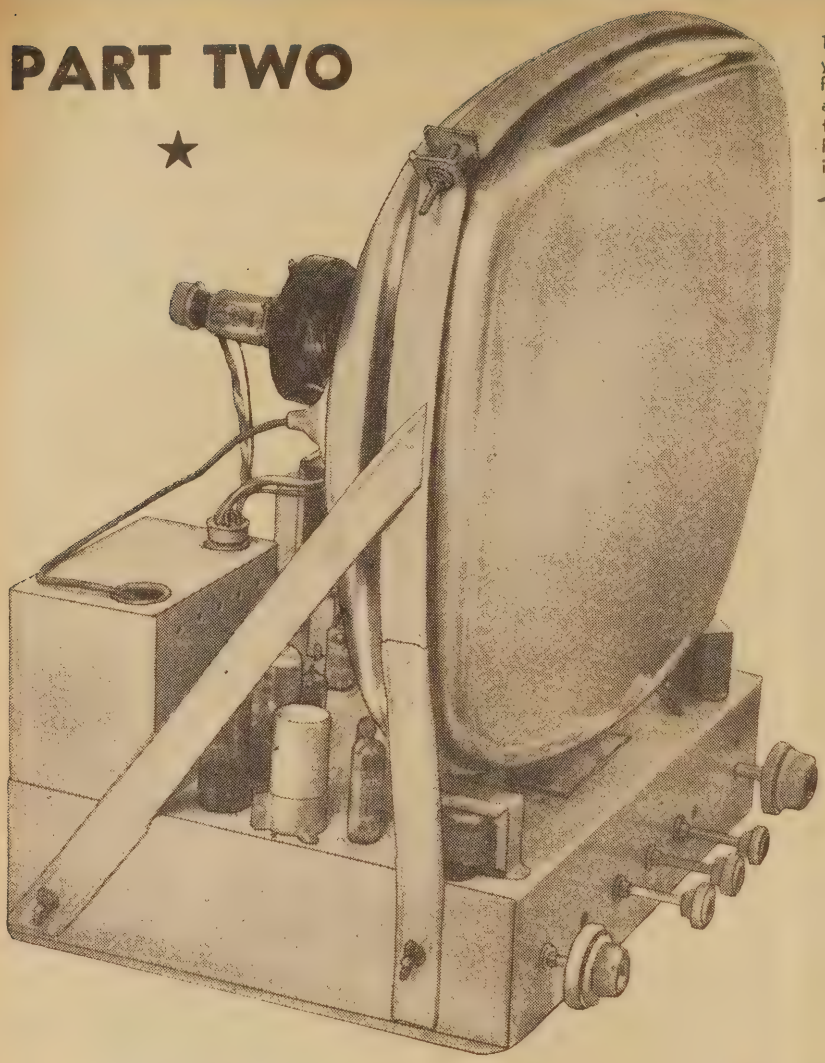

This is how your receiver will look by the time you have completed the work described in the following pages. The wiring underneath should also be a close copy of the original, in order to ensure the same order of performance. Penetration of line energy into other circuits is a particular hazard in 110-degree receivers.

How To Build The 1959 TV Set

This second long article continues the description of our new 110-degree television receiver. It details the remainder of the wiring and the mounting of the tube, so that, upon completion, the set should be capable of being switched on to receive pictures. Further information about adjustment, waveforms, voltages, etc., will be given next month.

IF the work detailed last month has been followed and completed, the set should be capable of giving good sound on all three channels, using a quite modest aerial. Failure to receive sound at this stage would indicate a fault and it should be located and rectified before proceeding further.

There are two reasons for saying this. Firstly, a component fault or error will obviously become more difficult to trace as the chassis fills up with components. Secondly, should the new wiring also contain a fault, some valve or component may be needlessly stressed while you are still looking for the original one!

Assuming, however, that the first section of the receiver does function correctly, the entire tuning system could conceivably be checked and aligned to save manhandling the chassis later, when it is in a much less portable form. At the same time, it would not be wise to have this done and then to dislodge the core settings by subsequent violent drilling and filing operations.

Since we had the necessary facilities to hand, we followed the obvious course of aligning the receiver at the "half-finished" stage, so that it required only a final "touch-up" when the job was completed.

Having obtained sound from all channels, the ideal procedure, thereafter, is to wire one stage at a time, checking as you go, using actual station signals and an oscilloscope. The swamp resistor in the transformer circuit can be reduced gradually, as stages are brought into operation, to keep the HT voltage at about 260 volts.

SIMPLE CRO

An audio type oscilloscope is quite useful for the purpose, provided you remember that it will tend to round off high frequency peaks and rectangular pulses. If no CRO is available, simply switch the set on after the completion of each stage and make sure that heaters light up and that volts appear on the plate and screen circuits.

Wiring and testing in this fashion, you may find that B-plus leads in particular should logically run to a source via a component board which has yet to be installed. We overcame this problem by looping long leads from completed sections of the receiver to their destinations, later re-routing, trimming and cutting them as each new section was added.

Note particularly that the high tension supply to the horizontal output stage and to the screen of the vertical output valve is not part of the main HT line, but connects to it through a "safety link" in the yoke wiring. Purpose of this is to prevent the deflection output valves operating accidentally at full power, without load and possibly causing flashovers.

We have taken a great deal of care in locating every individual component in the video, synch. and deflection circuits. While this contributes to neatness and accessibility, it is also vitally important in terms of performance.

In 110-degree receivers a very large amount of line energy can stray around

by **Neville Williams**

the chassis and completely cancel interlace, as well as causing the Line Hold control to be jumpy in its action. From what we can gather, quite a few prospective commercial designs have been stalled by these and other problems.

In our prototype receiver, the interlace is very close to perfect on all ordinary program material, and is not affected by rotating the Vertical Hold control, except at extreme settings, where the vertical oscillator is about to lose synch.

The Line Hold function is perfectly smooth, and, in both respects, the receiver is as good, if not better than the average 90-degree set, which we have handled.

Since we can only feel that this is, in large part, due to a carefully planned layout—we didn't build an "unplanned" set to prove it—we can only suggest, in the strongest terms, that the prototype be duplicated in detail.

WORTH FOLLOWING

This approach certainly appeared to "pay off" with our earlier receivers. We saw quite a few kitsets built up which looked almost uncannily like the original. And, significantly enough, the readers who seemed to get into the greatest difficulties were the inevitable few who just didn't bother to take our advice.

As it is, the diagrams and photographs reproduced herewith are more complete than for any of the earlier receivers and there should be less chance of going astray in terms of basic layout.

If you have an oscilloscope available, it will be possible to observe the video waveform on a station at the grid of the video amplifier. The same general waveform should be apparent at the plate but in opposite phase and amplified to a greater or lesser extent, depending on the setting of the contrast control potentiometer.

If you have not already done so, the components can now be added which divert some of the signal from the video amplifier plate to the triode section in the same valve which serves as a synch. separator.

This involves using a 3-tag strip. The 22K resistor runs from the video plate trap to one insulated tag, while the .022 mfd. capacitor bridges to the other. From this point a 270 pF. capacitor and .33M resistor in parallel run to the triode grid pin, with a 1M. resistor returning to the earthed lug.

MODIFICATION

[As mentioned in the panel of circuit notes, an advantage may be obtained in some cases by increasing the .022 mfd. capacitor to 0.1 mfd.]

Wired as suggested, the coupling components carry signals to the triode grid while having a minimum of capacitance to the adjacent triode plate pin.

All the actual plate circuit components are carried on the tagboard immediately in front of the socket.

The layout of components on this tagboard is shown in the accompanying diagram.

As mentioned last month, the first two lugs support the 22-ohm limiting resistor for the 6AW8 cathode. One end becomes a natural support point for the screen bypass while the other end is a junction

NOTES ON CIRCUIT AND DESIGN

A full schematic circuit of the receiver appeared in our last issue. Various important points are discussed in the following paragraphs.

PICTURE TUBES: Although it has been assumed that most constructors will prefer to use a 21-inch picture tube, the receiver can equally well take a 17-inch tube by simply modifying the support brackets. No changes whatever are required in the electrical circuit or wiring. Suitable 17-inch 110-degree tubes include the 17BZP-4 and the AW43-88.

SENSITIVITY: Some readers seem to have assumed that the new set is insensitive, because it includes three rather than four video IF stages. Actually, this is in line with the large majority of commercial receivers. Using the tuner and IF strip specified, and properly aligned, the set will resolve picture signals which are well down into the noise level set by the RF and mixer stages. It is doubtful whether extra IF gain would confer much practical advantage, particularly if the signals also have to compete with local noise and interference. The sensitivity of the sound channel is extremely high, so that lack of sound will never be a problem where any signal at all is available.

AUDIO HUM: In the position shown, the loudspeaker output transformer may pick up a small amount of buzz from the vertical output transformer. It can be heard by removing the 6BM8, while the rest of the receiver is in operation. The hum is almost completely cancelled by the negative feedback but it could be eliminated altogether by suitably orientating the loudspeaker transformer or by mounting the transformer underneath the chassis.

SYNCH. SEPARATOR INPUT: The time constant of the synch. separator input circuit involves a compromise between a number of conflicting factors. Provided sensitivity to hum is not increased or other ill-effects noted, the .022 mfd. coupling capacitor to the synch. separator grid circuit may be increased to 0.1 or even 0.22mfd. In some cases, the increase in value will minimise any tendency to curvature of vertical lines in difficult test patterns.

SYNCH. SEPARATOR OUTPUT: As noted in our last issue, the resistor shunting the synch. separator plate to ground has a vital bearing on the precise operation of both the separator and the following synch. amplifier. While the 39K value shown is a satisfactory output figure, in some cases, a lower value (viz. 33K or 27K) will minimise any tendency to picture weave with video content and give more consistent interlace. The value should not be reduced, however, to a point where picture lock is prejudiced, particularly under weak signal conditions.

HORIZONTAL OSCILLATOR PHASING: The position of picture information relative to the raster is determined largely by the horizontal oscillator feedback components but is affected also by stray circuit capacitance. Incorrect phasing may cause a slight compression or fold-over at one side or the other of the picture. White information at the edge of the picture may then appear as a smear behind the display proper, since it will brighten the start or finish of the return trace. To examine the edges, shift the picture — preferably a test pattern — bodily sideways with the centring magnets. If slight fold-over is evident at the left-hand edge, reduce or remove the 15pF. capacitor shunting the .15M. resistor in the oscillator feedback network.

VERTICAL OSCILLATOR: The vertical oscillator should ideally lock over most of the travel of the Vertical Hold control potentiometer, losing synch. at either end. The locking range on the potentiometer can be shifted by varying in value the 1-meg. resistor connected in series with the potentiometer. Depending on the tolerances of other associated components, it may typically need to be reduced to .82meg. or, more likely, increased to 1.2meg.

VERTICAL OSC. SUPPLY: The supply voltage to the vertical oscillator and also to pin 3 of the picture tube should approximate 400 volts. Its value will be influenced by resistor tolerances, load current and also by the leakage of the 8mfd. bypass capacitor. If it differs by more than about 20 volts from the target figure, as measured on a VTVM, after an hour or so of operation, appropriate correction can be made by varying the value of the 0.33Meg. resistor.

VERTICAL OUTPUT STAGE: A new valve, type 6EM5, has just been released for use in the vertical output stage of 110-degree receivers. It can be regarded as a plug-in replacement for the 6CZ5, being electrically very similar but with slightly improved characteristics and slightly higher ratings. As explained in the text, the 0.1 mfd grid coupling capacitor may need to be reduced to .022 mfd to preserve optimum linearity.

ERRATUM: "S" and "F" symbols were added by mistake to the damper diode choke instead of to the Linearity coil. An "F" symbol should be added to the end of the Linearity coil nearest the damper diode anode, and an "S" symbol to the end connecting through the safety link to B-plus.

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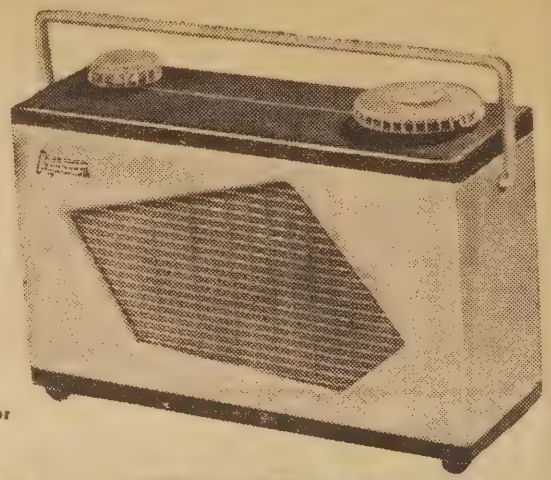

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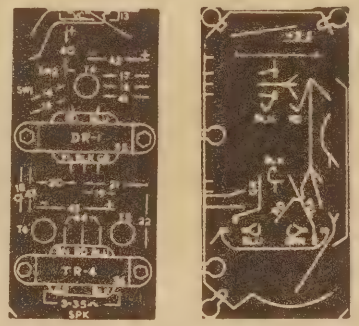
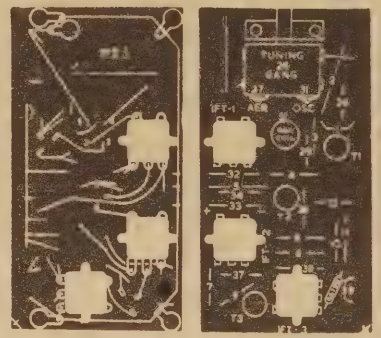


WB2 Silk-screened Wiring Board: topside and underside.



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for the coax. lead running forward to the contrast control. The braid can be earthed to a lug beneath the socket mounting bolt.

Note that the 68 pF. cathode bypass also mounts on this tagboard.

The components in the integrating and differentiating networks follow in logical order and concentrate on a lug which connects to the grid of one triode in a 6CG7. The plate of this same triode synch. amplifier connects to another lug on the same tagboard and is supplied from B-plus through other components mounted thereon.

An 82 pF. capacitor from this plate circuit feeds the horizontal synch. pulses to the nearby horizontal frequency control valve.

The board can best be wired before mounting in the chassis with trailing wires long enough to connect to the appropriate socket pins. Before beginning the job, however, check to see that the mounting holes correspond with those in the chassis and correct any inaccuracies with a "mouse-tail" file.

CARE WITH COMPONENTS

This and all other boards attach to the chassis by 1 x 1 1-8in whitworth bolt, passing through ¾in moulded spacers.

In attaching components to the tagboards, remember that small resistors and capacitors in particular can be damaged by stressing the leads or applying undue heat when soldering.

It is both unwise and unnecessary to mount miniature components hard against the board and solder within about an eighth-inch of their ends. They are likely to suffer damage and become difficult to replace for any subsequent service or adjustment.

Our advice is to allow a slight loop or slack in the pigtails of larger components and to mount the smaller ones deliberately about 3-8-inch away from the surface of the board, to minimise undue stress and heat.

Ideally, some sort of a "heat sink" should be used between the body of the component and the soldered joint, but this is not always practical, particularly where two or more leads have to meet at the one point. However, trouble can be avoided by working with a small, clean and hot iron tip and using a slight smear of flux if the solder does not otherwise flow readily.

Any residue can easily be removed from the completed board with a small brush and methylated spirit.

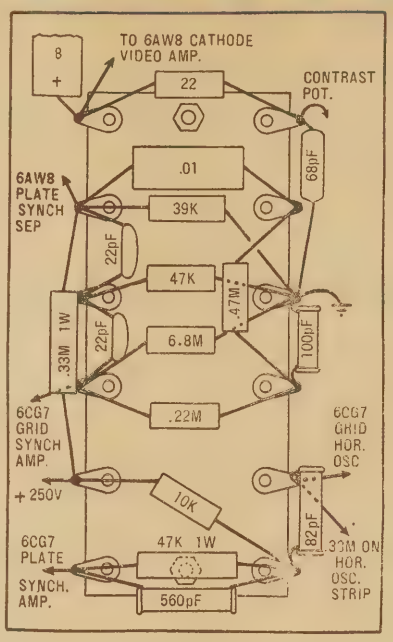
MOUNTING TECHNIQUES

Two techniques suggest themselves for attaching the components to the tagboards. One is to thread the pigtails through the eyeleted holes, along with any connecting leads, then support the components in the appropriate positions while a blob of solder is flowed around the wires.

The scheme makes for neatness but also calls for considerable care to avoid dry joints, particularly when several wires are involved. As a safety precaution, the board should be turned over, the surplus wire trimmed off and then soldered again from underneath. Do not bend the leads over before soldering because it makes the components difficult to remove later, if the necessity should arise.

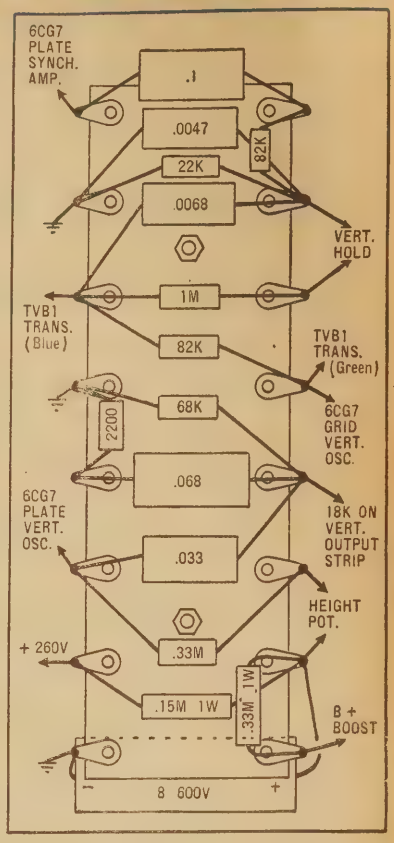
A second method is to hold each component in the appropriate position, bending the pigtails as required and with the ends turned inward or outward to lie along the surface of the respective lugs. The ends can then be trimmed and, if need be, pre-tinned.

When the tagboard has been completed, it can be checked and mounted in position with leads attached, as required, to permit its connection into circuit.



The above diagram shows the layout of components on the tagboard for the synch. separator and synch. amplifier stages. See text for further details.

On the right is illustrated the tagboard carrying most of the components to do with the vertical oscillator. Feedback components are on the companion board shown overleaf.



SOCKET ORIENTATION

As mentioned earlier, the function of synch. amplifier is performed by one triode section of a 6CG7 and the socket should be orientated to bring pins 1 and 2 adjacent to the tagboard just discussed. This will bring pins 6, 7 and 8 opposite a further board, which carries the components to do with the vertical oscillator.

Before wiring this, however, the synch. separator can be checked, if you have an oscilloscope available.

The sequence of components on the vertical oscillator tagboard is shown in a separate diagram on this page and the same remarks apply as earlier in respect to mechanical assembly.

One or two component values are worthy of special mention.

The 1.0meg. resistor in series with the Vertical Hold potentiometer sets the region on the element over which the vertical oscillator will hold. If the position is crowded to one end of the element or the other, due to an accumulation of tolerance variations in other components, it is quite in order to correct the condition by increasing or reducing slightly the 1.0meg. resistor.

Two resistors between B-plus and B-plus Boost (.15M. and .33M.) establish a supply potential for the vertical oscillator plate circuit and for the first anode of the picture tube. As measured on a VTVM, it should read about 400 volts, when the receiver is complete and in normal operation.

The potential will be influenced, however, by the leakage figure of the 8 mfd. electrolytic bypass. If the leakage should prove to be higher or lower than average and if, after a period of operation, the voltage settles at a good deal higher or lower than 400 volts, appropriate adjustment can ultimately be made to the value of the .33M resistor.

VERTICAL OSCILLATOR

The 220pF capacitor between the vertical oscillator grid and earth does not appear in our underneath photograph but should be wired at the socket, directly between the grid pin and earth. We used a miniature plastic encased type for the purpose.

The coupling capacitor from the vertical oscillator plate to the output valve grid mounts directly between the socket pins, the grid resistor also running directly from the socket to an earth point.

For purposes of test, the vertical os-

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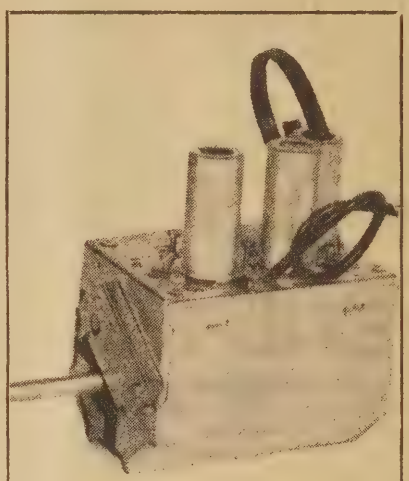

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cillator will operate at this juncture but not at full amplitude, because the normal HT supply voltage will not, as yet, be supplemented by the B-plus Boost voltage. This will also affect its blocking frequency and while the presence of a sawtooth output waveform can be confirmed with an oscilloscope, there is no point in worrying overmuch about where on the Vertical Hold pot. range it locks with the incoming synch. pulses.

Next logical step is to wire and instal the tagboard and other components to do with the vertical output stage. As mentioned elsewhere, the valve can either be the 6CZ5 specified or the newer type 6EM5.

LINEARITY

While the two types are similar electrically, the 6EM5 has slightly higher ratings and delivers higher peak current on drive. This is reflected, in a circuit designed for the 6CZ5, as a tendency to stretch the bottom of the picture and it may transpire that reasonable overall linearity is barely achieved with the Linearity potentiometer turned to its absolute minimum resistance position.

Rather than make wholesale changes in the operating conditions to correct this, it is only necessary to modify slightly the shape of the drive signal and this can be done, very simply, by reducing the value of the grid coupling capacitor from 0.1 mfd. to something like .022 mfd. This should bring the position of optimum linearity within the range of the Linearity potentiometer.

While the linearity is very good in any case, we gained the impression that almost perfect linearity would be obtainable in individual sets by choosing a critical value for the coupling capacitor, with either the 6CZ5 or the 6EM5, and making simultaneous and equally critical adjustment to the Height and Linearity controls.

However, the coupling capacitor should not be reduced so far, with this in view, that adequate height and linearity could not be maintained during the life of the output valve.

Connections to both valves are the same and the socket should be orientated so that the blank space between pins faces towards the large EHT socket.

Note that the grid is brought out to two pins and it is convenient to connect the grid coupling capacitor to pin 3 and the grid return resistor to pin 6.

The vertical output transformer should also be mounted. Make sure to grommet the hole through which the leads pass, to avoid any risk of chafing the insulation or inducing other conditions which may lead to a flash-over. The transformer must be of the type specified or specifically designed for the same circuit arrangement.

TRANSFORMER CONNECTIONS

Methods of portraying the transformer vary in different literature. In some cases it is shown as a simple tapped winding, in others as a double winding with two ends common. The point need not concern the constructor, however, since only three leads are normally available for connection.

What may be confusing is that the yellow and red leads in our circuit are the reverse in their connection to the yoke socket to those shown in some MSP and AWA literature. This is explained by the fact that we are using a different method of applying the vertical flyback blanking pulses to the picture tube and the leads must be reversed to obtain correct picture phase with flyback suppression—not flyback boost!

All three transformer leads run to lugs on the tagboard but two of them must ultimately continue on to join the deflection yoke attached to the neck of the picture tube.

The suggested method is to connect three long leads to appropriate points on the tagboard, using say 10/010 hook-up or something with equivalent insulation. Two of the leads are for connection to the yoke; the other carries the flyback suppression pulse.

WIRING DETAILS

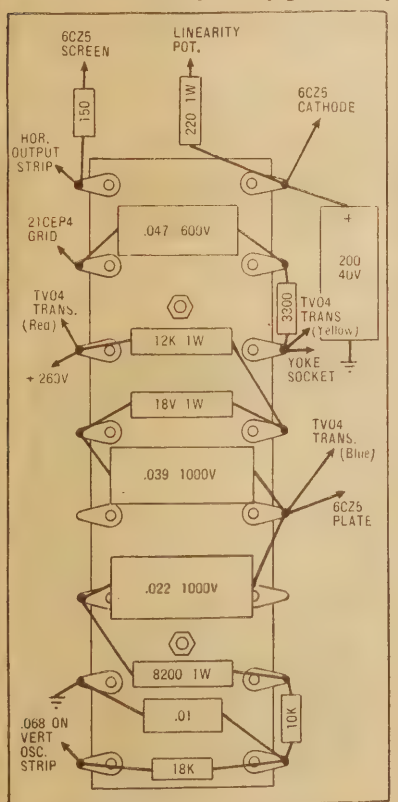
Twist the three leads together and run them directly back along the underside of the chassis, as evident in the underneath photograph. Two of the leads pass up through the chassis, then through the EHT cage for ultimate connection to the yoke socket. The third lead branches off and runs to the appropriate point on the video amplifier tagstrip.

For the time being, the two deflection leads can simply be taped off and rolled up above the chassis.

The diagram on this page shows the position of components on the tagboard which serves the vertical output stage. Two of the components bridge between the end of the strip and the socket, as indicated.

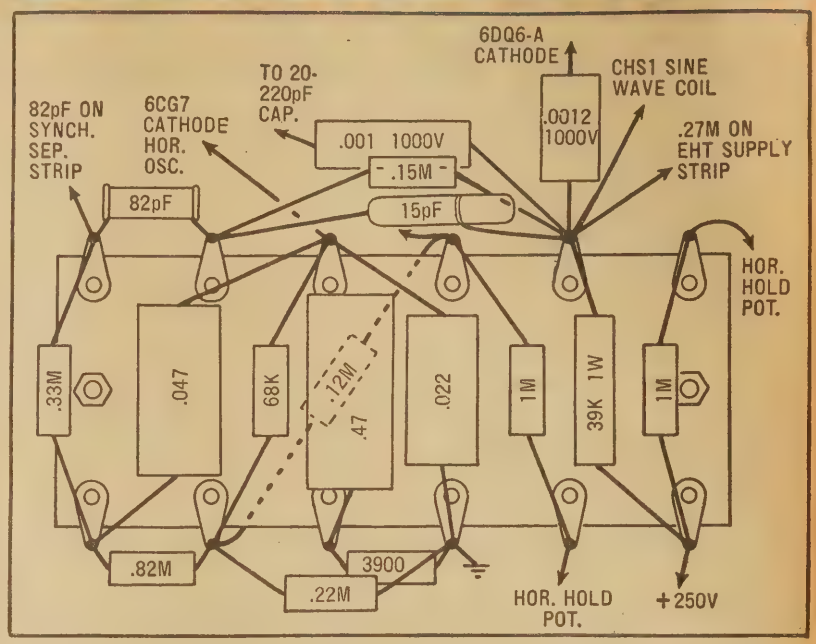
Thus the 150-ohm series screen resistor bridges between one lug and pin 1 of the socket. Note that the supply end of this resistor connects via the safety link in the yoke to B-plus so that, even though the output valve has plate voltage applied permanently, it cannot deliver significant power until the safety link circuit is closed by connecting the yoke.

The second resistor, a 220-ohm, bridges between the other end lug and pin 2, a



This board, carrying the components to do with the vertical output stage, is the same size as the vertical oscillator board and mounts alongside it, as indicated in the underneath photograph shown last month.

HORIZONTAL OSCILLATOR BOARD



Most of the components to do with the "synchroguide" horizontal oscillator are mounted on this board, with the "active" circuits facing the horizontal output tube.

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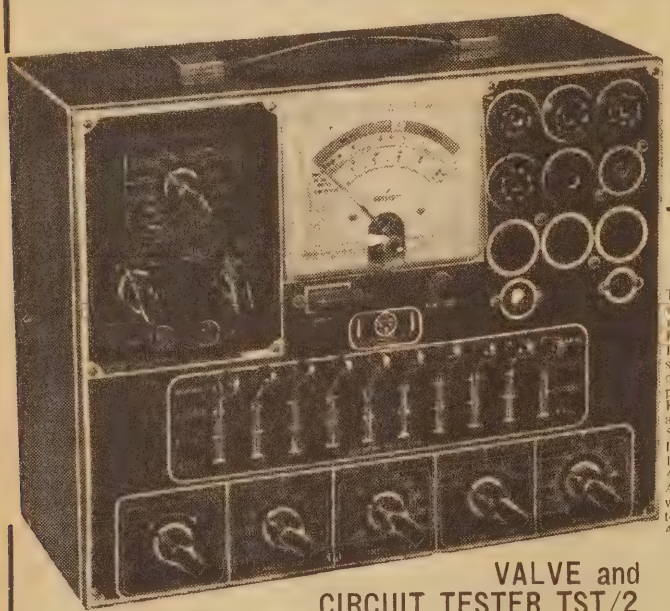

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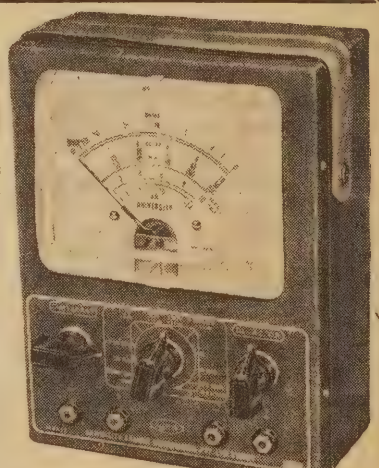

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wire running thence to the Linearity potentiometer at the rear of the chassis Thus, pin 2, which is blank, serves as a convenient anchor point.

The remaining components on the strip are self-evident, as will be their connection into circuit. Upon completion of this section, the vertical output valve can be plugged in, grid drive observed and plate voltage measured. It cannot operate normally, however, until the screen circuit is completed via the safety link.

Next portion of the wiring to tackle is the horizontal oscillator and control tube. The socket should be orientated so that the blank space between pins is toward the volume/brightness control. This brings pins 1, 2 and 3 for the control section handy to the synch. board, with the oscillator pins 6, 7 and 8 toward the horizontal output circuitry.

OSCILLATOR COIL

The oscillator coil mounts close to the valve, with its core adjustment within easy reach above the chassis for manual preset adjustment. The 39K resistor bridges directly between the "tapping" and "finish" lugs, both of which can be identified by inspection of the winding. Also from the "finish" lug, a 470 pF capacitor runs to pin 7.

The sine-wave coil mounts between the horizontal output valve and the electrolytic capacitor, its core being capable of adjustment from either above or below the chassis. Polarity of the connections thereto is not important, since it is a single untapped winding.

A .01 mfd. capacitor connects directly between its two lugs. This latter should be a good quality component and, while we have not specified a close-tolerance type, it must certainly not be a high-K capacitor, which could be way above its marked value. A plastic encased type is, once again, a good choice.

Be very careful in mounting these two coils, which are normally fitted with spring clips, designed to push through holes in the chassis and to lock automatically. Use a small file, if necessary, to clear the holes or remove any burrs and do not crush or collapse the former by squeezing or stressing it near where it attaches to the metal clip.

Make sure it is facing in the right direction before pressing into position, but, if the coil has to be removed, compress the ends of the clip carefully so that it will slide out without forcing.

WIDTH, LINEARITY

The same general remarks apply to the width and linearity coils when you come to mount these later on the rear face of the chassis.

Practically all the other wiring components to do with the horizontal oscillator mount on a tagboard as illustrated, or bridge between it and other circuit points.

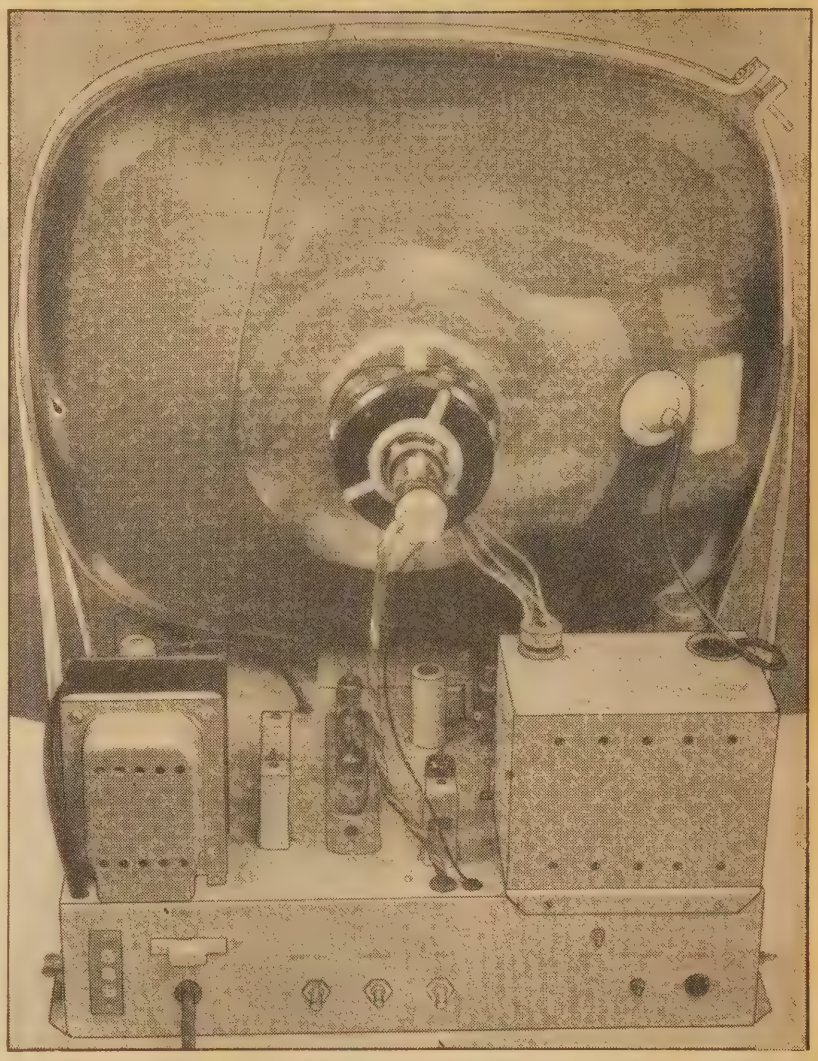
The .0012mfd. capacitor runs direct to the 6DQ6 cathode pin, while the .001 runs to one side of the drive adjustment, whence one resistor runs to the 6DQ6 grid and another back to chassis. Take the precaution, before mounting the drive capacitor, of unscrewing the adjustment to its minimum capacitance position.

With the wiring completed up to the grid and cathode circuits of the horizontal output valve, the horizontal oscillator should generate sawtooth waveforms and be capable of being synchronised to station pulses, if you have a CRO to observe same. However, its behaviour will be affected by the fact that supplementary supply voltage, derived from the B-plus boost circuit, will not yet be available.

Wiring the horizontal output valve and the damper diode is a simple matter mechanically in this receiver, because there are no brackets or sub-assemblies to complicate the task. However, a good deal of care is necessary to effect the proper connections, without error, between the horizontal output transformer the yoke socket, the width and linearity coils and the various minor components

And here a word of explanation. Trouble has occurred in odd receivers of many types with "spook" lines, due to overshoot from the trailing edge of the synch. pulse rendering the spot visible about half-way along its return trace. In this receiver we have taken the precaution of including a horizontal retrace blanking circuit to minimise this possibility.

A REAR VIEW OF THE CHASSIS



A rear view of the chassis. From left to right, the adjustments are "Vert. Lin. "Height," "Focus," "Width" and "Hor. Lin." Note how the yoke plugs into a socket on top of the EHT cage. A length of braid, running from the top of the tube support to the chassis, grounds the outer coating on the picture tube.

While investigating this subject for an article some months ago, we were impressed by the excellent rectangular pulse which was present across the width coil, though it was wrongly phased for immediate use in our own receiver. We considered the possibility of using a width coil with a supplementary winding but, to the best of our knowledge, no such component existed on the local market at the time.

COMPONENT AVAILABLE

When we took the matter up again for this present design, we found that AWA had produced a double-wound width coil for their own use and we were able to arrange for it to be released through MSP for the new RT & H receiver.

Actually, it is not ideal for our particular purpose, because the voltage available—about 5 P-P—under average conditions is less than we would have liked. However, it is certainly worth having, since its inclusion involves no

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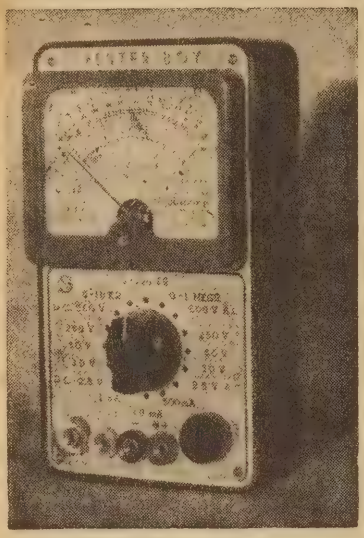

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20	21	4d	8/
22	23	3d	8/3
24	25	2d	8/9
26	27	2d	9/4
27	29	2d	——
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more than a few inches of wire.

As will be seen from the circuit, the supplementary winding is shunted by a 180-ohm resister to limit ringing and is connected in series with the capacitor which would otherwise bypass the picture tube grid to ground. The coil must be phased to apply a negative-going pulse to the grid during flyback.

When wiring this final section of the receiver, it is logical to mount all the key components on the chassis. An ordinary good quality moulded socket will do for the horizontal output valve but a mica-filled type is suggested for the damper diode. In both cases, the keyway should be at 45 degrees, towards the front and adjacent end of the chassis

The special skirted EHT socket should be mounted with the keyway towards the adjacent rear corner.

Mount the horizontal output transformer as shown in the photograph, inserting grommets where the leads have to pass through the metalwork.

The numbers on our circuit diagram correspond with numbers stamped in the bakelite panel of the horizontal output transformer, and should obviate any difficulty about identifying connections.

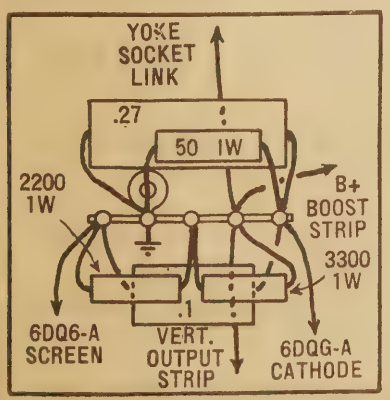
4-TAG STRIP

We suggest that a 4-tag strip be mounted on the chassis just in front of the transformer to provide an anchor point for the 4,700-ohm resistor and the .039mfd. capacitor which connect in series with two of the leads to the yoke socket.

The other ends of these components and the two 270pF. capacitors attach directly to appropriate lugs on the transformer panel. A close-up of the wiring is shown in the accompanying photograph.

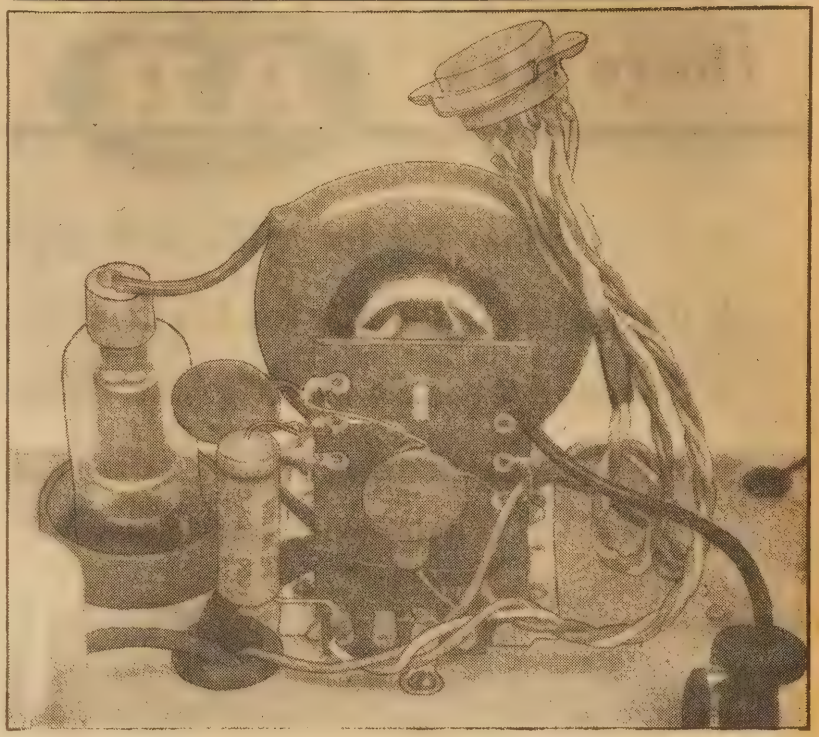
We suggest that a mica-filled socket be used for the yoke connection, and preferably one with a metal shell. To this, sweat a couple of brass nuts so that it can be attached readily to the underside of the cage top with short bolts.

The leads to the socket should be long enough to allow it to be manipulated into position, but not so long that they will press against the lugs on the transformer panel. In point of fact, it is a good plan to lay a strip of plastic tape around these lugs, after wiring, to minimise the risk of peak voltages puncturing the insulation of any wire which does happen to brush against them.



A 5-tag strip, wired as shown, mounts near the horizontal output valve and carries some of its supply and bypass components.

VIEW OF WIRING IN EHT CAGE



The very small amount of wiring inside the horizontal output cage contrasts with our earlier design. Note the leads to the yoke socket, which attaches to the underside of the shield box.

If the resistor is a type which has the element covered only with a layer of paint, slip a piece of nylex tubing over it to prevent breakdown to the capacitor.

We have specified a double hole in the side of the cover to allow the horizontal output plate cap to pass through, yet retain the grommet which is also fitted to the lead.

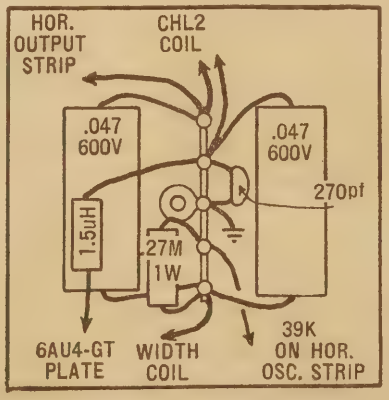
The EHT lead passes up through the cage and out through a large diameter hole in the top. Though it may not be strictly necessary, we suggest slicing a piece of nylex tubing lengthwise and cementing it around the edge of this hole, again to minimise the risk of voltage puncture.

Four self-tapping screws hold the cover to the chassis proper and there is therefore no problem in installing or removing the cover at any time.

Under the chassis two small tagstrips support the components serving the damper diode and line output tube respectively. Note that the 5,600 2W. resistor was made up, in our case, from a 3,300 1W. and a 2,200 1W. in series.

It is a simple matter of wiring to interconnect all these components, as indicated by the circuit.

It is obviously essential to connect the width coil and its secondary winding correctly to ensure that the pulse applied to the picture tube grid is negative-going. This can be verified with a CRO but, for those who lack this means of checking, we are including a diagram showing the connections in the original receiver.



A second 5-tag strip, this time mounted near the damper diode socket carries components to do with the B-plus boost circuit.

WRONGLY MARKED

We have noticed one small point of error in the circuit diagram relating to the Linearity coil. The polarity of this coil is probably not important, because it is a single, untapped winding. However, we had intended to mark it "S" and "F" for "start" and "finish," merely to conform to the manufacturer's literature.

Unfortunately, the "S" and "F" marks were transposed to the choke coil in the damper diode plate coil, where they are quite meaningless, this coil having no essential polarity.

The "F" mark should therefore be transferred to the end of Linearity coil adjacent to the damper diode anode and the "S" to the end running to B-plus via the safety link.

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rectifier can be mounted across vacant pins in the skirted socket.

The filament of this rectifier is supplied through a loop of heavily insulated wire around one leg of the horizontal output transformer. Make sure to grommet the hole in the chassis through which the leads pass and avoid stressing or kinking them en route.

Trim to length and connect them to pins 2 and 6 of the rectifier socket, the 1.5 ohm series resistor then bridging between pins 6 and 7 to complete the circuit. The 1000-ohm series dropping resistor can connect between either 2 or 7 and pin 4, which becomes the junction point to the outgoing EHT lead.

Suitable EHT lead and connectors can be purchased but, if you have any difficulty in getting a long enough piece, it is better to arrange a substitute, rather than try to effect a join in two shorter lengths.

A very good EHT lead can be made by obtaining a length of small diameter stranded coaxial cable and sliding off the outer covering, then the braiding. Replace the outer covering only, and you have a light, stranded lead with a double thickness of insulation.

FIRST CHECK

With the output wiring thus complete, you can proceed to check its general operation by simply plugging in the yoke and switching on. Make sure, however, that the EHT lead is swinging in free air.

Even without the picture tube, the yoke will load the output circuits normally and you can check relevant waveforms with a CRO, as well as metering the Boost and EHT voltages.

If no special probe is available to measure the EHT, pick up the lead a few inches from the "business end" and bring it toward the chassis. It should start to hiss as it approaches the metal and a spark something like an ignition discharge should jump the final ¼ to 3-8 inch, indicating that the anticipated EHT voltage is there to operate the tube.

The final major item for consideration is the mounting of the picture tube. This can be approached in two ways.

If your cabinet is to be one of the "loughboy" types, the picture tube will normally have to be supported by the cabinet structure, quite independently of the chassis. Right now, we can say no more about this, except to mention that one or two of our advertisers appear to be working on it as a purely cabinet design project.

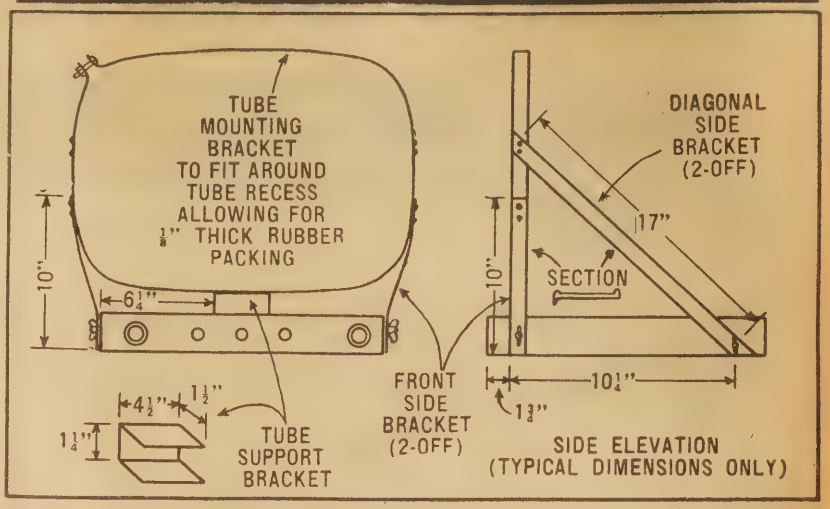
ATTACH TO CHASSIS

On the other hand, if the picture tube is to mount above the chassis, there is a lot to be said for attaching its support brackets directly to the chassis, so that the whole assembly can be handled as a single unit, as in the illustrations herewith.

Testing is very much simplified and no special brackets or cleats are necessary in the cabinet, other than those which are needed to hold the mask and safety glass in place. The hazard of having a tube exposed does not appear in practice to be a very real one.

The exact fore-and-aft position of the tube on the chassis will still be influenced by the cabinet design, and will therefore call for some forethought. In our prototype chassis, we mounted the

DETAILS OF THE TUBE MOUNTING



This diagram illustrates the general dimensions and position of the tube mounting bracket on the prototype receiver. While the tube position is typical, it will need to fit in with details of the cabinet and the relative positions of knobs, mask and safety glass.

21CEP4 picture tube in an "average" position, with the maximum curvature of the screen overhanging the chassis by about ¾ inch and the socket overhanging at the rear by about 3/8 inch.

Assuming that you have the chassis otherwise complete, it will be possible to measure the position of the knobs on the tuner and on the volume/brightness potentiometer. Armed with this information and knowing how you want to finish the front panel of the cabinet, it should be possible to draw a side elevation diagram to cross-check the position of the mask, the safety glass and the picture tube.

TUBE HIGHER?

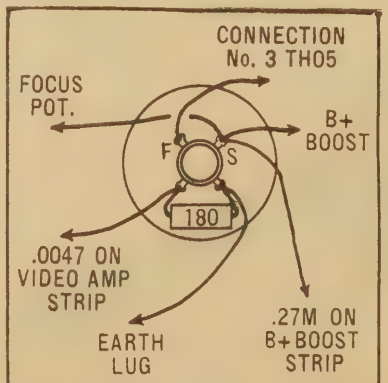
If the latter has to be moved back to suit your requirements it may also have to be raised by about a quarter-inch to clear the vertical output transformer. Alternatively, there is room on the chassis for this latter component to be swung a little toward the back if you have to conserve overall height.

The tube bracket arrangement suggested is very similar to that used for our last receiver, with one important amendment. In this case the brackets are attached to the chassis by ¼-inch Whitworth bolts and wing-nuts.

For normal tests and minor alterations the chassis can be rolled easily on to the power transformer side. However, if there is an urge to tidy up the wiring and the solder joints thereafter, the whole tube and bracket assembly can be removed in about one minute flat, allowing the chassis to be turned on its back for convenient working.

The entire mounting bracket for the original receiver was fashioned from standard aluminium beading of the section shown. It is about 1 1-8 inches wide, has two decorative ridges on one side and a small lip on the other, being intended normally for edging around tables and shelves.

The beading is suggested mainly because it is readily workable and is a standard item of hardware. There would be no objection whatever to using flat ¾-inch-wide mild steel strip if you can arrange to obtain some.



Here are the connections to the width coil viewed from the end carrying the lugs. The secondary winding for flyback suppression has fewer turns and lower DC resistance, and can be identified readily with an ohmmeter.

BEADING WIDTH

The aluminium beading is actually wider than the ¾-inch dimension suggested by the tube manufacturers as the optimum clamp size, but it does not bear directly against the glass. Between the two we ran a strip of sponge rubber measuring about ¾ by ¼ inch.

To fashion the clamp will normally involve using the picture tube itself, and it goes without saying that the greatest care is necessary to avoid dropping the tube, or dropping anything on it or knocking the neck off with an unscheduled swing of the arm.

Our suggestion is to stand the tube, face down, on a carpet or on a small mat on an otherwise clear table. Loop the sponge rubber around the face of the tube—about 5ft will be required—and stretch it a little so that it will cling to the tube under its own tension.

Lap the ends and join them with a staple made from copper wire. The extra bulk involved will not matter, provided

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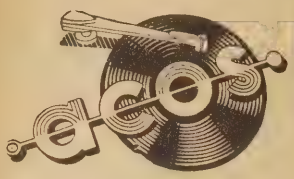

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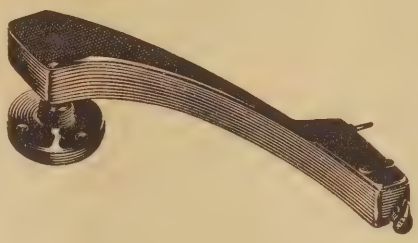

HGP38 A Crystal pick-up. Incorporates the HGP37 turnover cartridge for standard or microgroove recordings with cantilever stylus.

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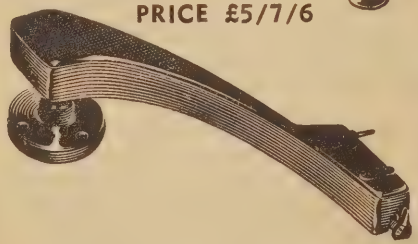
GP66: Series of lightweight pick-up with die cast arm construction increasing torsional rigidity, minimising arm resonance. Complete (with GP65-1 or GP65-3 cartridge).

PRICE £5/7/6



GP50: Is a high-output crystal pick-up suitable for reproducing standard and microgroove records through low-gain amplifiers as used in small record players. (Cartridge GP59-3).

PRICE £4/19/6

GP32 Magnetic pick-up provides a good standard of reproduction with normal equipment at low price. Output voltage, ½ volt at 1,000 c.p.s.

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GP61 CARTRIDGE
A Ceramic turnover cartridge that will withstand the rigours of a tropical climate and is, at the same time very robust.

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GP65 Turnover crystal cartridges available in two types, medium output High Quality or High output.

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GP59 CARTRIDGE
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the join is located between the open ends of the clamp.

The diagram and pictures show the clamp junction adjacent to one corner of the screen. There is a particular reason for this, in that the bolt and junction lie completely within the natural rectangle bounding the tube and chassis. It will therefore not add, either to the overall height or to the overall width.

To form the clamp, by the way, you will need a strip of metal slightly under 6ft long.

Take the beading (or other suitable metal) and bend the end outwards at right angles in a vyce. If using the beading suggested, plan for the lip to be to the front and inside the loop.

Carefully form the metal around the rubber on the face of the tube, starting from the corner where the junction is to be. Make sure that the lip on the beading comes in front of the rubber and correct any errors of curvature as you go, working only with the fingers, to avoid sharp kinks.

SHOULD FIT NEATLY

When the band is completely encircling the tube and pulled tight by hand, there should be no obvious gaps between it and the sponge rubber. Trim the remaining end and bend it outwards at right angles, to produce a gap between the faces of about 1¾in.

Drill ¼in holes through each end, close to the bend, to receive a 2 x ¼in Whitworth bolt, which will be adequate to tighten the clamp.

In fact, it is a good plan to tighten the clamp enough to grip the tube face firmly and to note the distance which remains between the ends. If the clamp is then moved and screwed up by this same amount, it can be attached more accurately to the supporting struts.

This done, the tube can be put back safely into its carton.

Unless you need to change the position of the tube relative to the chassis, the next step is to make up the small U-bracket shown on which the tube clamp rests. With the "U" facing forward, drill holes in the underside to correspond with those in the chassis.

Attach the bracket to the chassis, then rest the clamp on top of it, centring it as accurately as possible on one of the longer "sides." Drill holes through the bracket and clamp, countersinking those in the clamp to receive countersunk bolts. Bolt the two together but slip a couple of washers between them so that the clamp will not be flattened at the bottom when the bolts are tightened.

VERY RIGID

At this stage, the clamp will seem hopelessly insecure but don't rush to the conclusion that it will always be this way. With the addition of braces from the side of the chassis, it becomes extremely rigid.

Cut the shorter braces first and file the lip off the beading where it will ultimately bear against the chassis and the clamp. Drill holes and attach the two shorter braces to the chassis, at the same time bending them outwards and upwards till they support the clamp symmetrically above the chassis.

Be careful about this, otherwise you may find the tube sitting slightly to one side or tilted just enough to look odd.

Drill a couple of holes through the top of each brace and through the corresponding position in the clamp, securing them together for the time being with 1/8in bolts.

Now fashion two more clamps to run from the rear of the chassis and bolt them so that they hold the clamp exactly vertical when viewed from the side. (This will be the normal requirement; in special cases the constructor may desire to tilt the tube face and later the safety glass slightly forward.)

Having verified the relative positions, we suggest that the clamp and braces be removed from the chassis and assembled as a rigid unit, using bifurcated rivets, flattened against the metal.

It can thereafter be attached to the chassis, using six short bolts and wing nuts—one for the end of each brace and two to secure the U-bracket to the chassis. Loosen the clamp and, with the rubber already on the face of the tube, it should be possible to slip the latter in position, tightening the clamp to hold it secure.

If the job has been done carefully, the tube should be very rigid and quite capable of supporting the weight of the chassis, when it is rolled on its side for inspection or adjustment. As mentioned earlier, if the chassis needs to be turned over on its back, undoing the wing nuts will release the whole tube and harness in very short order.

At this stage, the mechanical work on the chassis is virtually complete and the next step is to make the necessary adjustments to secure an optimum picture.

The matter of adjusting your new receiver will form the subject of a special article next month.

(To be continued.)

A HOT AIR ENGINE

SINCE 1946 the Philips company in Holland has been doing research and development work on the hot gas engine, first proposed by Stirling in 1817. Having found difficulty in making a single piston do the double duty of displacing the gas from the cold to the hot space and of transmitting the power of the hot, expanded gas, the researchers have now resorted to two pistons, one for each job, and are getting good results from a 40 h.p. engine working on this principle.

The cycle depends on external heating and is therefore a closed cycle. In the cylinder are two parts, one heated and one cool. The air or gas is introduced by an external tube connection from the cool part into the hot and is compressed between the two pistons. On expanding and communicating its energy to the power piston it is exhausted through the same connecting tube into the cold part until the reciprocal stroke of the displacing piston sends it back into the hot part and the cycle is repeated.

Among the engine's advantages are a low noise level, low consumption of lubricating oil and little wear because of the absence of corrosive substances, freedom to use almost any gaseous or liquid fuel and a small torque variation over a wide range of engine speeds. In the new engine the drive mechanism consists of twin crank and con-rod systems offset from the engine axis, the crankshafts being coupled by gear wheels and rotating in opposite senses.

With this system there is no need to pressurise the whole crankcase but only a small cylindrical buffer at the base of the power piston. Engine output can be regulated by altering the mean working pressure of the gas in the cylinder.

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R. and H. Bench type VTVM case chassis printed front panel, £2/14/, plus 12½ p.c. tax.

R. and H. Audio Signal Generator case chassis and printed front panel, £4/13/6, plus 12½ p.c. tax.

R. and H. RC Bridge case chassis and printed front panel. £3/4/6, plus 12½ p.c. tax.

R. and H. Audio Distortion Meter, case, chassis and printed front panel, £3/4/6, plus 12½ p.c. tax.

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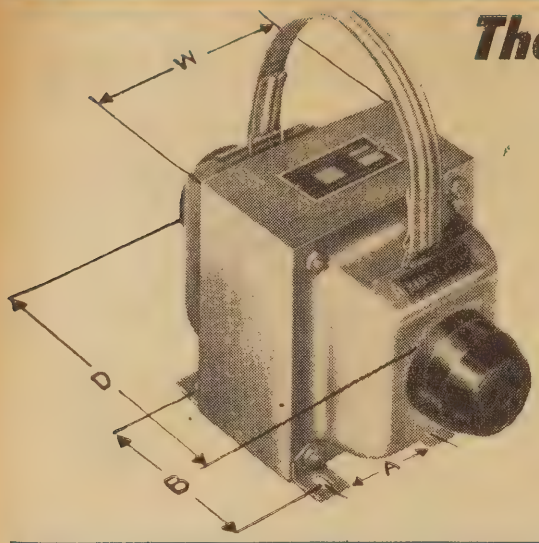

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Type	Sec. Volts. AC	Watts	Type of Outlet	No. of Outlets	Dimensions (in inches) H	W	Max. D	A	B
B12/7	4, 8 & 12	7	Terminals	1	2"	2 3/8	5 7/8	3 1/8	
Scope Trfr.	3.3	30AInt.	"	1	3 3/4	3 1/8	3 7/8	2 1/2	1 7/8
FT6/15	6.3	15	Leads	1	1 15/16	2 3/8	1 7/8	1 7/8	
BT7.5/11	7, 5, 8, 5, 9, 5 & 11	11	Terminals	1	"	"	"	"	
SD6/18	6	18	"	1	3 3/4	3 1/8	2 3/4	2 1/2	1 5/8
SD6/30	6	30	"	1	"	"	3 7/8	2 1/2	2
SD6/60	6	60	"	1	"	"	4	"	2 1/8
SD6/100	6	100	Terminals	1	"	"	4 3/4	"	2 7/8
SD12/60	12	60	Terminals	1	3 3/4	3 1/8	4	2 1/2	2 1/8
SD2/100	12	100	"	1	"	"	4 3/4	2 1/2	2 7/8
SD32/60	32	60	2 Pin Polarised	1	3 3/4	3 1/8	4	2 1/2	2 1/8
SD32/100	32	100	" " "	1	"	"	4 3/4	"	2 7/8
SD32/175	32	175	" " "	1	4 3/4	4 1/8	5 3/8	3 1/4	3
SD32/250	32	250	" " "	1	"	"	6	"	3 3/4
SD32/500	32	500	Terminals	1	6 1/2	5 3/16	5 5/16	3 3/16	5 15/16
SD32/1000	32	1000	"	1	6 3/4	5 3/8	9	—	—
SD110/25	110	25	2 Pin	1	3 3/4	3 1/8	3 1/2	2 1/2	1 5/8
SD110/60	110	60	" "	1	"	"	4	2 1/2	2 1/8
SD110/100	110	100	" "	1	"	"	4 3/4	"	2 7/8
SD110/175	110	175	" "	1	4 3/4	4 1/8	4 3/4	3 1/4	"
SD110/250	110	250	" "	1	"	"	5 3/8	"	3
SD110/400	110	400	" "	2	6 1/2	5 3/16	4 3/8	3 1/8	5
SD110/500	110	500	" "	2	"	"	5 5/16	3 3/16	5 15/16
SD110/750	110	750	" "	2	8 1/8	6 1/4	4 3/8	4 3/16	4 15/16
SD110/1000	110	1000	" "	2	"	6 3/8	5 3/16	4 3/8	5 13/16
IS240/150	240	150	3 Pin	1	4 1/8	3 7/16	4 3/4	2 3/4	2 7/8
IS240/250	240	250	" "	1	4 3/4	4 1/8	5 1/2	3 1/4	3 3/8
IS240/500	240	500	" "	2	6 1/2	5 3/16	5 5/16	3 3/16	5 15/16
IS240/1000	240	1000	" "	2	6 3/4	5 3/8	9	—	—

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National Stepdown & Isolation TRANSFORMERS

✻ APPLICATION GUIDE

Application	Voltage	Wattage	Max. continuous Current	Use Transformers
Bells and Buzzers	4, 8, 12V	7	0.6A	BI2/7
Scope Tools	3.3V	—	30A intermittent	Scope Trfr
Filaments and Pilot Lamps	6.3V	up to 15W	2.5A	FT6/15
TV Picture Tube Booster Transformer	7.5 to 11V	11W	1.0A	BT7.5/11
Soldering Irons	6V	Up to 18W	3A	SD 6/18
Pilot Lamps		18W to 30W	5A	SD 6/30
Filaments		30W to 60W	10A	SD 6/30
Heaters		60W to 100W	16A	SD 6/100
A.C. Toys	12V	up to 60W	5A	SD 12/60
Motors		60 W to 100W	8A	SD 12/100
Battery Chargers				
Display Lights	32V	Up to 60W	1.9A	SD 32/60
Drills		60W to 100W	3.1A	SD 32/100
Safety Lights		100W to 175W	5.5A	SD 32/175
Relays		175W to 250W	7.8A	SD 32/250
Appliances		250W to 500W	15.6A	SD 32/500
		500W to 1000W	31.2A	SD 32/1000
Imported Appliances	100 to 117V	up to 25W	1.23A	SD 115/25
Shavers		25W to 60W	1.55A	SD 115/60
Test Equipment		60W to 100W	1.91A	SD 115/100
TV Receivers		100W to 175W	1.6A	SD 115/175
Radios		175W to 250W	2.3A	SD 115/250
Projectors		250W to 400W	3.6A	SD 115/400
Tape Recorders		400W to 500W	4.5A	SD 115/500
		500W to 750W	6.8A	SD 115/750
		750W to 1000W	9.1A	SD115/1000
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		150W to 250W	1A	IS 240/250
		250W to 500W	2A	IS 240/500
		500W to 1000W	4A	IS 240/1000

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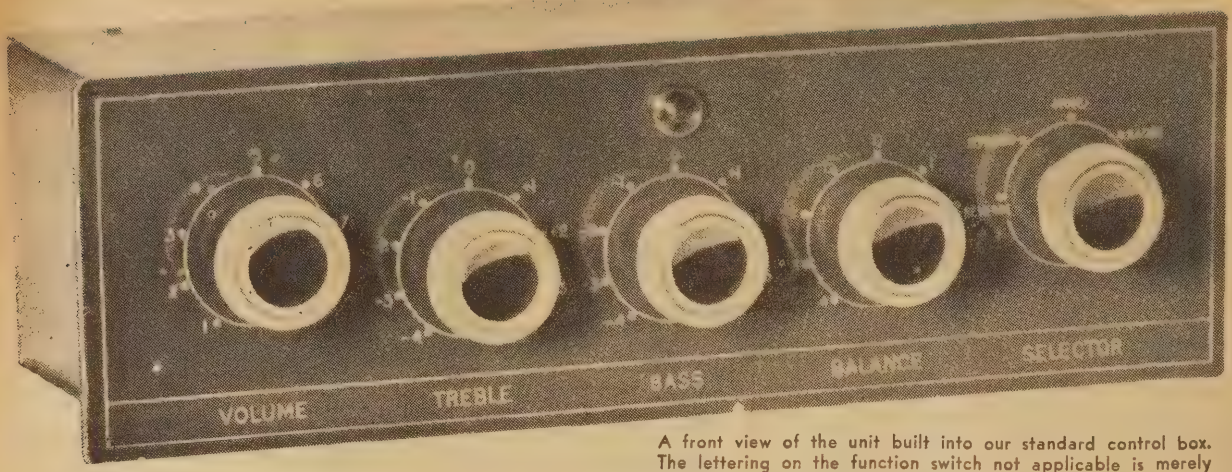


A front view of the unit built into our standard control box. The lettering on the function switch not applicable is merely ignored, or a new panel could be made

Continuously Variable Crystal Tone Control

Here is a simple and very effective circuit of a tone control unit for use with standard crystal pick-ups of the mono type. It is built into one of our standard new type control boxes, although its physical shape isn't particularly important.

by John Moyle

READERS will remember the series of control units which have been produced and described during the past few months, with special reference to stereo records.

The convenience of having a standard type of metal work for these boxes has paid ample dividends, for it has been of great assistance not only to suppliers but also to those who build them.

The layouts have been so arranged that rebuilds are simplified from one circuit to another, to accommodate possible changes between pick-up types, and this is a great advantage when looking to the future.

In order to achieve this, we adopted a form of unit construction, particularly in respect to the brackets which hold the valve sockets and their associated components.

BRACKETS IDENTICAL

Except for an odd hole which could be easily drilled in any event, these brackets are identical, the valve sockets and essential tag strips being in the same respective positions.

The same goes for the function switch and the other controls, the only difference being that dual types are used for stereo, whereas single types are used for the mono versions.

The unit described here is the simplest of them all, because the connection for a standard LP crystal pickup is the simplest also.

But the flexibility of the scheme can be demonstrated as follows:

The first venture into sound might well be by using an amplifier served by a straight crystal pickup as mentioned above, and this design shows how it is done.

Essentially it is the same circuit as would be used for a stereo crystal pick-up except that only one of the channels is wired in place.

As far as possible the same connections on the tag strips have been used as for the stereo type, so that if and when the time comes to expand the unit for stereo the least number of circuit changes will be needed.

The bass, treble and volume controls are in the same respective positions. If you think there is a chance that you will eventually go to stereo, and that's almost a certainty, it would probably be a good thing to buy dual potentiometers in the first place with a saving in overall cost.

On the other hand you may have some pots around of the correct value, and you could, of course, use these for the time being.

Changing to stereo, therefore, is something of an add-on process.

The present circuit requires only one triode, but if you buy a twin type, and use only one section for the time being, that would be quite in order.

For magnetic pick-ups we have already described a stereo and a mono version in which the same general principles apply. Because the circuit required is more extensive than for crystal, you would need to start off with more parts, but the change to stereo is again merely a matter of mounting the valves and components for the extra channel.

The change from crystal to magnetic pick-ups will call for different valve types, but there are still many points of the circuit in common.

BASS, TREBLE CONTROLS

This refers mainly to the rear end of the unit which includes the bass and treble controls.

These are exactly the same for either type of pick-up, so that the alterations are largely confined to the front end.

In all cases the metal work and even the front panel markings are the same, even if some of the stereo positions so marked are ignored for use with mono.

The only point at which the stereo has no counterpart in mono is the balance control.

This control is peculiar to the two channels, and provides a means of balancing the gain between them within reasonable limits — quite an important thing to watch for stereo.

For mono use this control position can either be ignored for the time be-

ing, or used to provide a rumble control.

These days records are so good that the need to cut the bass to reduce its effects is more likely to indicate some serious shortcoming in the equipment or the turntable than anything else.

However, we can put this control position to work by including a device to cut the bass response below about 50 cycles, and this we have done. You can please yourself about it.

It would be possible to make the control unit smaller by using a different box which omits the rumble control, but we do not think this would be wise unless you want to save space and are quite sure that stereo will not enter into your plans.

And that's a risky decision to make these days!

CIRCUIT SIMPLE

The circuit is extremely simple and uses a minimum of parts. It is assumed that the unit will operate with a Playmaster type of main amplifier which will have a sensitivity of about .2 or .25 volt, which is the output we want for the unit for full output from the amplifier.

Remembering that this refers only to the loudest peaks of sound, much louder than would be required on the average, the working input voltage for the amplifier will be very much lower than this.

Most mono crystal pick-ups give appreciable output. Some of the best-quality types would produce about .16 volt from a standard test disc and could run well over one volt on peaks.

Other types will give at least .5 volt from a test disc and up to several volts on peaks.

So it will be seen that we don't really want any gain at all from the control unit — in fact, in the case of the higher output pick-ups we can do with a loss in gain and still have enough to fully load the amplifier.

To use a control circuit which had a gain of even two or three times between input and output would only embarrass us. We would have to operate the gain control almost off all the time, and there would even be a danger of overloading the first valve from the pick-up output.

For this reason we have used a valve which, in our circuit, will give a gain of about 11 or 12 times, knowing that nearly all of this will be lost in the tone control circuits which follow it.

Thus we have a position in which the effective gain of the unit is, in fact, about zero.

INPUT DIVIDER

The best technique is to use a voltage divider circuit in the input by which the output of the pick-up is reduced to such an amount that, with the gain control turned full on, the volume is the maximum amount you feel you could ever stand

This means automatically that at all times the valve will receive the least amount of input voltage we can get away with, and it will therefore be operating at the minimum distortion point.

The amount of distortion produced by the valve is extremely low in any case, as there is ample margin of grid swing if we connect it as shown.

The values we have suggested for the input resistors provide about half the available output from the pick-up for the amplifier, and this would be a reasonable operating condition for all except perhaps the highest output class of pick-up.

The point to watch is that the total value of both resistors is the same as that set down as the recommended load for the pick-up, for it is, in fact, the pick-up load.

Usually this is about .5 megs. Larger values will give more bass, smaller values less bass.

Because there is a wide variation of bass in the bass control circuit which is largely complementary to the variation brought about by small differences in pick-up load, you do not have to be over-meticulous in this matter, variations up to even 50 per cent being allowable without drastic result.

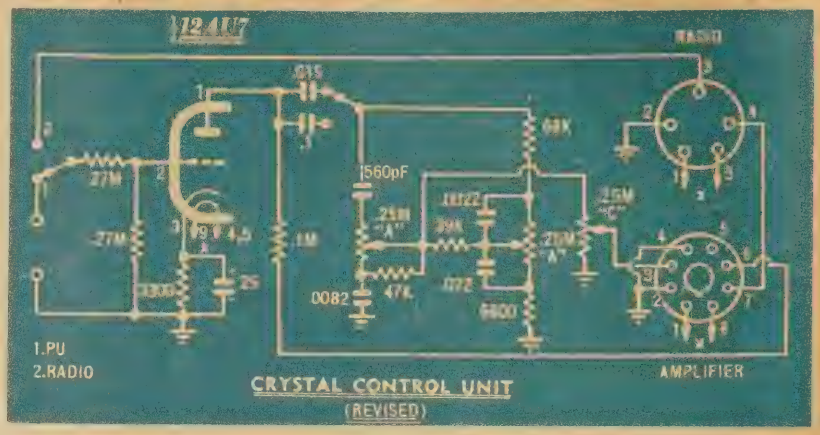
COMPENSATION CIRCUITS

Some high-quality pick-ups are used with special compensation circuits to modify their response. It is in order to use such circuits in place of the one shown, provided they are not designed to cut the bass drastically to simulate a magnetic type. With such networks you would, in fact, need to use a control unit designed for magnetic pick-ups.

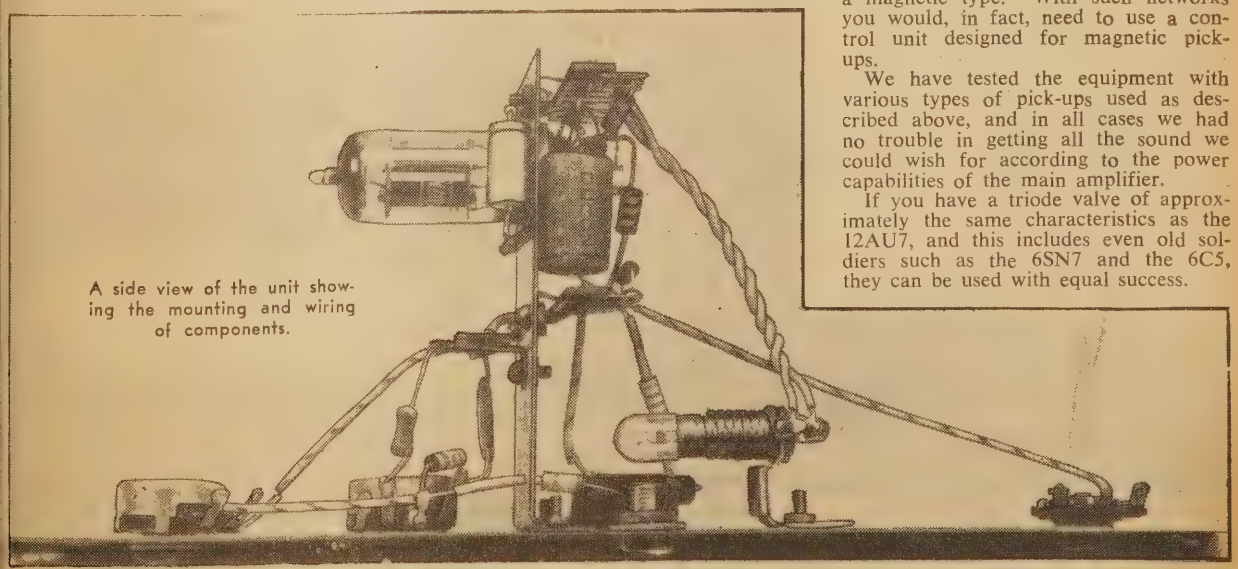
We have tested the equipment with various types of pick-ups used as described above, and in all cases we had no trouble in getting all the sound we could wish for according to the power capabilities of the main amplifier.

If you have a triode valve of approximately the same characteristics as the 12AU7, and this includes even old soldiers such as the 6SN7 and the 6C5, they can be used with equal success.

MONO CONTROL UNIT CIRCUIT



The circuit is the essence of simplicity. Provision is made to connect a radio tuner.



A side view of the unit showing the mounting and wiring of components.

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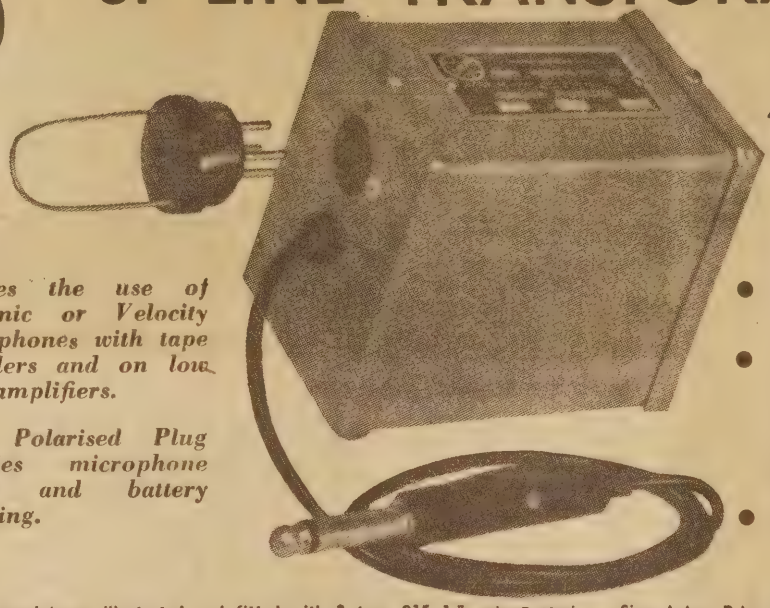

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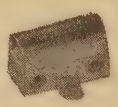
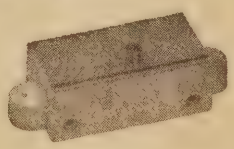


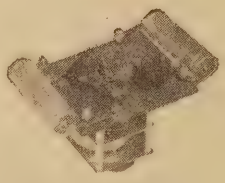
TYPE B



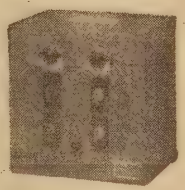
TYPE C

TYPE SF

TYPE 1
TEMPORARY USE ONLY



TRAFFIC WARNING FLASHER



LIGHTHOUSE BEACON FLASHER

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INDUSTRIAL WARNING DISPLAYS

D—25-100W, 230v. AC/DC. APPROX 12 FPM CONT. RATING.
B—25-100W, 230v. AC/DC. APPROX. 12 FPM CONT. RATING.
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SF—5 AMP, 6, 12, 24, 48v. AC/DC. INSTANT START 40 OR 80 FPM CONT. RATING.
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MOTORISED UNITS, ETC., TO ORDER.

QLD. H. MARTIN, Wilson House, Charlotte St., Brisbane. B 1785-6.
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RONALD J. T. PAYNE PTY. LTD
385 BRIDGE ROAD, RICHMOND, VIC.
JB 1416.

But do not use high gain triodes such as the 12AX7 or 6SL7, as these will provide too much gain and exhibit other disadvantages.

The fact that larger octal sockets would be needed for some of the valves mentioned is of no significance, except that larger holes will be needed to accommodate them, and these you will have to drill out for yourself. Socket connections, too, will be different.

The tone controls are of the continuously variable type and provide a cut and boost in both instances of about 12-15 db either side of zero.

This is enough to take care of any reasonable contingency, and the circuit is very effective and free from incipient troubles.

GAIN CONTROL

One big advantage is that the gain control appears at the end of the circuit chain, so that, when it is in the off position, any noise from the pre-amplifier is not included.

It's only a minor point in this instance, although more important in the higher gain units, for, as we have already mentioned, the over-all gain of this circuit is almost exactly nil.

The rumble filter consists merely of an extra switch which brings in a smaller coupling capacitor if required to reduce the bass response by 3 db at 50 cycles. The roll-off then continues at approximately 6 db per octave, so that there is an appreciable amount by the time the significant rumble frequencies are reached. A value of .02 mfds will be suitable.

As you will see, there is no power supply filtering included in the circuit, for it is assumed this will be built into the main amplifier as it is in the latest 17-watt Playmaster.

If you have to provide this filtering, it could be of a simple type, because, as the gain is not great, there is virtually no danger of motor-boating and little amplification of hum voltages.

A decoupling resistor of about 25K and a 50 or 100 mfds filter capacitor feeding back to the main power supply would probably be all you would need.

It is assumed that the voltage available from this power supply is approximately 300 volts.

STANDARD CONNECTION

As is normal with these control units, the input comes via an octal socket, and we have used the same order of connections as will be found in them all.

A second socket with 5 pins to avoid confusion is included to connect a tuner, and this can normally use the high tension of the main amplifier. Most tuners require about 200-250 volts, and a separate decoupling circuit is often used with a resistor of about 5,000 ohms, probably 5 watt, and an 8 mfd electrolytic capacitor.

One important point to be noted is that the filament circuit is not earthed to the body of the box in any way. Its earth is provided for in the amplifier, preferably from a winding which has a centre tap.

See that, when you mount the indicator light, one side does not earth the filament line. Most of them have an insulated mounting method, but keep your eye on it, all the same. It's one that has puzzled many in the past.

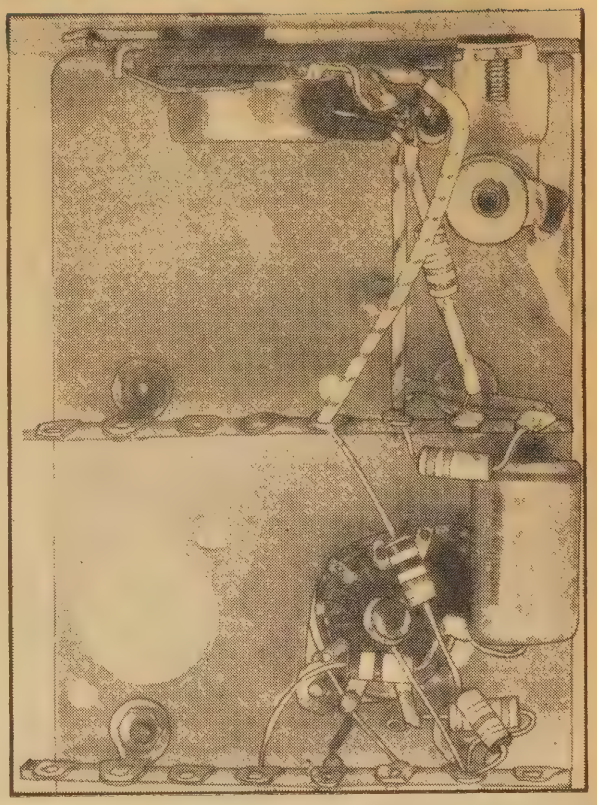
A CLOSE-UP VIEW OF THE WIRING

It's important, too, to see that connections to the unit from the pick-up are made with shielded leads even to the extent of using shielded connectors. These need not be elaborate, but the idea is to see that the very minimum of unshielded lead is used right up to the pick-up head itself. Because of their high impedance such unshielded lengths are prone to pick up hum and noise.

☆

Photograph of the bracket ready wired.

☆



S.S.B. USED IN OFFICIAL U.S. JET

From their new 600-mile-per-hour jet plane, top U.S. government officials will be in continual touch by radio with points anywhere in the world where there are communications facilities.

THE five and a half million dollar plane, a Boeing VC137 and the first of three to be delivered for use of both military and civilian officials, was shown to the Press recently.

Aboard the big four-engine jet is some of the most modern communications gear in the world.

A key element is a revolutionary long-range communications system using single-sideband radio, the AN/ARC-65 system, developed by Radio Corp. of America and used in Strategic Air Command bombers for world-wide communications.

Incoming messages are reproduced by a teleprinter in the plane by means of a single-sideband converter.

Conversely, the unit adapts outgoing teletypewriter messages for radio transmission. Message secrecy maintained by use of supplementary equipment.

For all official messages, the executives aboard the plane will rely on the teletypewriter, although voice radio is also available when needed.

The normal channel would be through the Pentagon communications centre, which can "patch in" the exchange of messages with other communications facilities, including the Signal Corps teletypewriter network, the SAC network, the Bell System network, and RCA Communications for transmissions abroad.

It can also be in direct contact with SAC bases both in the U.S. and abroad and with the North American Air Defence Command.

Because of its range and dependability, the SSB system will thus assure that Government officials can be in touch at any time with the Pentagon, the White House, Government offices, defence posts, foreign Governments, and other offices throughout the world.

The jet plane, a military version of the Boeing 707, will be used mostly by Cabinet members and other high officials.

The President will continue to use the "Columbine" as his personal plane, using the jet probably on rare occasions.

It is interesting to note that the communications systems on most SAC bombers are now being converted from an earlier double-sideband system in use since 1953 to the new single-sideband system.

The plane also has installed an emergency-channel u.h.f. transmitter-receiver, a weather radar, and many other electronic navigational devices. A hi-fi tuner is even included for AM and FM radio broadcasts.

TANDBERG tape recorder extraordinary

People who know about tape recorders will already know about TANDBERG—the tape recorder extraordinary which puts so many of the best features and so much performance into a neat 22lb package. The latest TANDBERG machine, the 3-speed, 4-track Model 5 Stereo, has the same features, appearance and performance as the still current Model 3BF, and is also the first 4-track stereo machine on the market.

Winning features of the TANDBERG have always been their compactness, reliability, ease of operation and "studio-machine" performance.

All models have the traditional polished walnut surrounds measuring 15in long, 11 5/8in wide, 6 5/8in high, and each is contained in a pigskin carrying case from which the top can be completely removed.

Wow and flutter are below 0.1 p.c. at 7½in per second. Frequency response for all models is: 70-5,000 c/s at 1 7/8; 40-10,000 c/s at 3¾; 30-16,000 c/s at a speed of 7½.

RANGE AND QUALITY

For dictation, or when a long, uninterrupted playing time is more important than maximum high frequency response, a tape speed of 1 7/8 i.p.s. will give virtually perfect reproduction of speech. Music lacks only the brilliance obtainable at higher speeds, but there is no audible wow or flutter.

At 3¾ i.p.s. music is recorded with quality and presence never before attained at this speed.

At 7½ i.p.s. TANDBERG gives the truest high-frequency full range sound so far attained only with big studio machines at a speed of 15in per second.

Frequency response at all speeds is given as plus or minus 2 db. and the signal to noise ratio is 55 db. below highest recording level.

GOOD DESIGN

The mechanical operation is controlled by a single gear-shift type knob at the right. For recording or play-back the knob is pulled forward; for rewind it is pushed to the left; for fast forward, to the right. A mechanical interlock prevents accidental erasure.

Starting and stopping is smooth with no spillage of tape, and instantaneous starting can be obtained by pulling the knob forward slightly to start the motor before engaging the idler wheel against the highly polished capstan.

A speed control knob at the top between the reels selects the desired speed and changes tape equalisation at the same time.

Just above this switch is the speaker control which connects the internal speaker to either of the two channels in the case of stereo or disconnects it entirely.

To the left of the lower head cover is the main function control switch with positions for record, playback and public address. In the latter position the microphone is fed directly through the amplifiers and speaker.

The volume control knobs are dual in the stereo machines with a friction clutch causing both to turn at once in normal use, but balancing can be done by displacing one with respect to the other.

Under this dual knob is a lever which selects the mode of operation—stereo or mono tracks 1-4, or mono tracks 2-3. The level indicator eye is just above the volume controls and to the left is a bass-lift switch which increases lows by 12 db. at 70 c.p.s. A unique time indicator accurately locates any part of the recording.

All inputs and outputs except the microphone, which plugs into a jack on the top panel, are available at a terminal panel at the rear. A small compartment is provided for the power cord.

STEREO RECORDING

Apart from producing a marvel of compact design, TANDBERG are obviously setting the pace in terms of tape recording technique.

The 3-speed, twin-track Model 3 set the standard of TANDBERG design and performance which remains unchanged and unmatched. It also incorporates an electrically operated foot-control.

The advent of 4-track stereo tapes has tended to supersede the Model 3 with the 3-speed, 4-track Model 4, which also has the foot-control. In this model the second stereo channel is fed into a pre-amplifier of 0.5 Volt high impedance output for feeding into an existing power amplifier.

The new Model 5 Stereo carries the process one step further. A power output stage is included for each stereo channel. The addition of two high quality loudspeakers is all that is necessary for playing back either 2-track or 4-track stereo tapes.

Finally, a Stereo Record Amplifier measuring 8¾in long, 2¼in wide and 5¼in high, is available for Models 4 and 5 to enable high quality stereo recordings to be made.

TANDBERG tape recorders are distributed throughout Australia by **Simon Gray Pty. Ltd.**, of Melbourne, and are available through the leading retailers.

WALL TELEVISION

Television on-the-wall has moved a step closer to reality. A new experimental television display screen—brighter than any previously reported and no thicker than a picture frame—has been introduced by Westinghouse, according to recent reports.

DEVELOPED by scientists at the Westinghouse Research Laboratories in Pittsburgh, Pennsylvania, the display screen represents an important forward step in efforts to replace the bulky, high-vacuum television picture tube by a flat, bright "solid state" display screen.

The Westinghouse display unit is called an "Elf" screen. It gets its name from the words "electroluminescent" and "ferroelectric." The screen combines in a single structure an electroluminescent panel—in which light is obtained from a flat surface—and a flexible, built-in ferroelectric storage and control structure.

"A satisfactory solid-state display screen is an important objective of modern electronic research," the Westinghouse spokesman said. "When such a screen is fully developed it can be used to carry radar pictures or other information in aircraft, show the ever-changing air traffic pattern around an airport, or bring TV-on-the-wall to the average person's living-room."

There are inherent disadvantages in the unit that now carries the TV picture, the cathode ray tube: inconvenient size and shape, limited maximum brightness and susceptibility to "picture-flicker." This has stimulated interest in a solid-state display screen for both military and commercial applications.

Recent progress made by Westinghouse Lamp Division experts in the development of bright and efficient electroluminescent phosphors has led the company to believe that they offer the best approach to a flat, efficient, solid, non-vacuum-state display.

Recent experimental models of the Elf screen built at the Westinghouse Laboratories are less than a quarter of an inch thick and three times brighter than a conventional TV screen, the company's representatives report. The contrast ratio between the light and dark areas of the screen is as high as 200 to 1.

Images can be stored on the Elf screen for several minutes. Due to the flexibility of the ferroelectric storage and control, they can be changed many times a second if desired. There are no inherent limitations on the size of the Elf screen; a window-size display actually would be easier to construct than one the size of the usual television picture tube.

One of the outstanding features of the cathode ray tube—its ease of "scanning" or signal distribution—will be one of the hardest to duplicate. Westinghouse technicians say they regard this as the major problem yet to be overcome in perfecting the Elf screen.

Continuous excitation of the screen by a storage-and-control system is regarded as the first step toward a successful device. The problem of distribution of signal information—accomplished in the cathode ray by the scanning beam—is now being attacked.

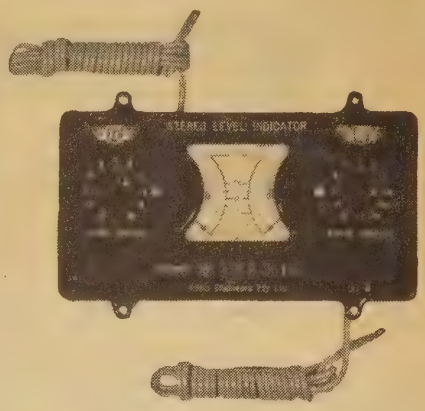
sarlon REGD

PLASTIC GRILLE CLOTH

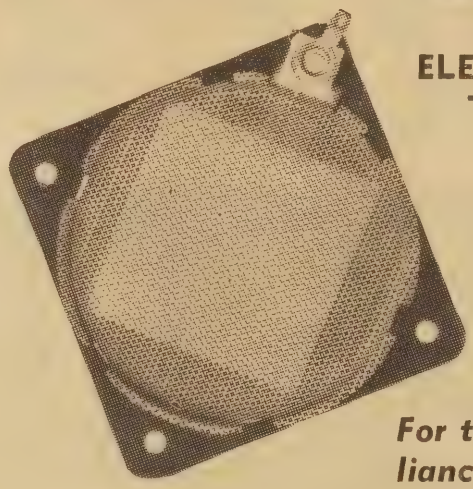
Acoustically correct The ultimate in grille fabric. Available in a wide range of patterns and colours with a scientically designed open weave guaranteed no attenuation of high note response from speakers.

Priced at 6/- per square foot cut to 6-inch multiples.

LEVEL INDICATORS



Invaluable for all stereo or mono applications, these sensational meters have excellently damped movements, frequency response flat from 20 cycles to 20,000 cycles, sensitivity variable at will between 1.9 volts and 23 volts full scale deflection, in four models: Stereo Model ST-A (portable) or ST-B (panel mounting) (illustrated), £8/7/6. Monophonic Model AU-A (portable) or AU-B (panel mounting), £4/17/6.



HI-FI AE ELECTROSTATIC TWEETERS

Further supplies are now available in three models.

AE Model LSH75 Price 16/6

AE Model LSH518 Price £1/2/6

AE Model LSH100 Price 1/7/6

For that extra brilliance install an AE ELECTROSTATIC.

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Assemble your own speaker and control cabinets!

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" " 'AL12' — 12in speaker cabinet.
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All Audiokits are complete with easy to follow detailed instructions.

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Stereophon LIVING SOUND

16 VALVE HI-FI STEREOGRAM CHASSIS

Complete tuner and amplifier for stereo, comprising a compact Hi-Fi Stereogram in two units featuring a high gain dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls in one unit and two Mullard 5-10 amplifiers with push-pull outputs and power supply on second chassis. **£69/15/-** F.O.R.

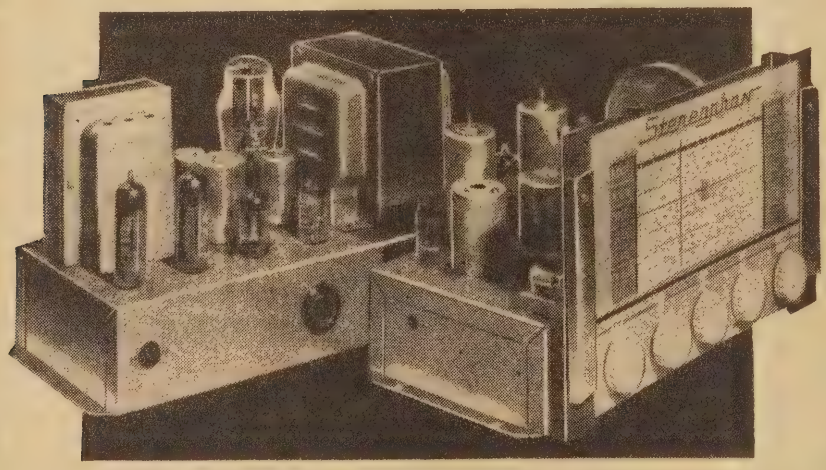
Two pair of M.S.P. Jensen speakers or two Rola 12in dual coned speakers supplied. Power output 10 watts per channel (20 watts). Frequency response of amplifier 40 to 15,000 cycles.

10 VALVE HI-FI STEREOGRAM CHASSIS

Complete stereo unit comprising dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls and two Mullard 3-3 amplifiers, power supply on separate chassis. Supplied with two Rola 8MX speakers. Power output 4 watts per channel. Frequency response of amplifier 40 to 15,000 cycles. **£48/15/-** F.O.R.

8 VALVE HI-FI STEREOGRAM CHASSIS

Complete tuner and amplifier for stereo incorporating the "Mullard 3-3" amplifier circuit with separate bass and treble controls. Output 3 watts per channel. Supplied with two Rola 8MX speakers. Frequency response 50 to 10,000 cycles. **£38/15/-** F.O.R.



ALL UNITS INCORPORATE THE NOW FAMOUS "MULLARD" AMPLIFIER & TONE CONTROL CIRCUITS.

SPECIFICATIONS ON OPPOSITE PAGE

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Nine and ten valve chassis incorporate the Mullard 5-10 AMPLIFIER CIRCUIT. Frequency response 40-13,000 cycles. Max. output 10 watts. **£42/15/0** F.O.R.

A NEW 1 VALVE DUAL WAVE RADIOGRAM CHASSIS

WITH BASS AND TREBLE BOOST.

The ideal chassis for those difficult locations where reception is doubtful. Specifications as nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short-wave bands. **£45/15/0** F.O.R.

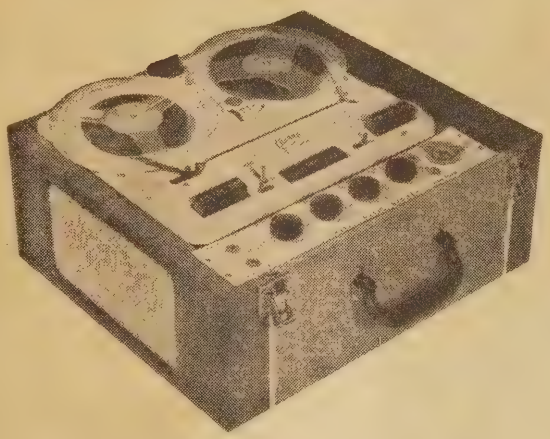
ALL CHASSIS GUARANTEED FOR A PERIOD OF SIX MONTHS. ALL 4 SPEED STEREO RECORD CHANGERS AND PLAYERS STOCKED.

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145.

Buying a Tape Recorder?

First see and hear the new Hi-Fi Recorder by Classic incorporating the new Collaro Mark IV Transcription deck. The only deck with ALL these features.



THE COMPLETE UNIT IS SUPPLIED IN ATTRACTIVE AND DURABLE TWO-TONE COVERED CASE COMPLETE WITH ACOS MICROPHONE AND FITTED WITH DUAL ROLA SPEAKERS.

The seven-valve amplifier, including level indicator, incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Record monitoring and outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with perspex dress plate to match deck.

- **HIGH FIDELITY**
Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "playback" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
- **INSTANTLY REVERSIBLE**
Instantaneous changes can be made from one track to the other. Fast rewind in either direction
- **CONSTANT TAPE TENSION**
A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan.
- **FULLY MECHANICAL**
No solenoids are used in the construction of this Transcriptor. The braking is entirely mechanical.
- **FINISH**
Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
3¾, 7½ and 15 inches per second.
- **FOUR HEADS**
Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.
- **PAUSE CONTROL**
This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
- **TAPE MEASURING & CALIBRATING DEVICE**
The three digit counter makes the location of any recorded passage the simplest of operations.
- **TRANSCRIPTION TECHNIQUE**
A large diameter flywheel with ground and lapped steelshaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter at less than 0.15 to 1.0 per cent.
- **TWO MOTORS**
Each dynamically balanced motor does only one job at a time. Motors never act against each other and are of low wattage input with consequent reduction in heat and wear.

COMPLETE RECORDER WITH MIKE — 84 GNS. f.o.r.

DECK WITH AMPLIFIER, POWER SUPPLY and 6in x 9in SPEAKER, 71 GNS.

AMPLIFIER AND POWER SUPPLY FOR COLLARO DECKS WITH VALVES (7) £34/10/- f.o.r.

SPECIFICATIONS OF OUR NEW HI-FI CHASSIS

NEW:

Ultramodern circuit using nine high gain valves including "magic eye" tuning indicator. Permatuned iron cored coils and intermediates giving excellent interstate reception and a short-wave range of 12,000 miles. All valves used are the new Mullard nine-pin Innoval series.

NEW:

Tone control and audio stages incorporating the Mullard 5/10 amplifier circuit with separate bass and treble controls giving plus or minus 15 db boost or cut at 50 cycles L.F. and 10,000 H.F., combined with push-pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favourite recordings.

NEW:

Dual speaker combinations using the new Jensen M.S.P. 12PR woofer with matched tweeter and cross-over network giving a frequency response of 40 to 12,000 cycles. If required the Rola 12MX speakers can be supplied (with the 8 valve stereo chassis, two Rola 8MX speakers are supplied). A.W.A. output transformers used on all units.

NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

NEW:

Large calibrated edge-lit dial in perspex (11in x 6in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Dial can be supplied in cream, black or brown with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control. Audio end of set can be used with TV receiver if required.

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145.

You can trust your servicing reputation
TO RELIABLE
STC BRIMAR
VALVES

S.T.C. Brimar Valves can be counted on to maintain top performance well past the point where other valves begin to fail. That's the quality that puts them in front for service replacements — *the factor that upholds your reputation for quality TV and radio servicing. Standardise on S.T.C. Brimar Valves — let their proven performance be the mark of your servicing efficiency.*

Standard Telephones and Cables Pty. Ltd.

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N15

SHOCK WAVES

SHOCK waves produced by violent motion, such as an explosion, are, like sound, compressional waves, but they can travel faster than sound. This is well known; but now Wladimir Philippoff of Philadelphia has found evidence that an explosion can set up a disturbance which travels far faster even than a shock wave—up to 30 kilometres per second in glass.

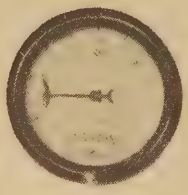
He was studying the shock waves produced in plates made of glass and transparent plastics by exploding lead azide and photographing the compressional waves using a brief flash of polarised light. The light flash followed a chosen number of microseconds after the explosion so that the phenomenon could be observed at different stages. The observations showed that the shock wave, in glass, travelled at 5½ kilometres per second.

However, Philippoff also noted sharp dark lines on his photographs, well in front of the blurred line of the shock wave, at the far corners of the plate. When he let off a charge at each end of the plate he found dark parallel lines between the approaching shocks. And when he observed cracks appearing in the glass as a result of the explosion, he found that even these could progress in advance of the compression.

Philippoff suggests that the basis of an explanation of his surprising discovery may be a very fast wave which travels over the surface of the material.

TIME
GENTLEMEN

C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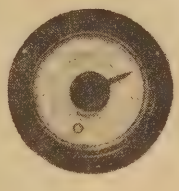
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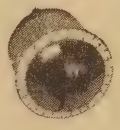
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TRADE REVIEWS AND RELEASES

NEW FERRIS HYBRID RECEIVER FOR SIX VOLT VEHICLES

Owners of 6 volt cars and trucks have hitherto been denied the advantages of the latest designs because the hybrid valves do not perform effectively with this potential applied to the plates. Ferris have overcome the difficulty by employing auxiliary dry cells.

A SMALL metal container houses four No. D50 cells which are connected in series and in series with the 6-volt supply from the car battery to supply the plates of the valves only. A current of 8mA maximum is drawn from the batteries when the set is operating, giving them an estimated life of at least one year with ordinary use.

This appears to us to be an excellent practical solution to the problem of making an efficient, economical set for 6-volt primary supply.

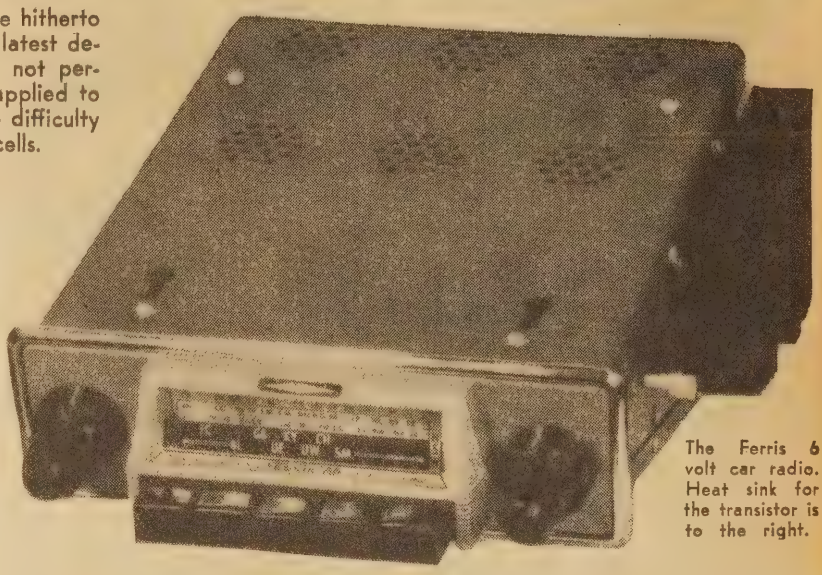
Main battery drain is only 2½ amps at 6 V.

On test, the general performance of the receiver compared more than favourably with other receivers with which it was compared. Away from local electrical interference, stations within a 50-mile radius came through at excellent signal-to-noise ratio in daylight hours on a short car aerial. At night we would expect long-range reception.

The press-button tuning mechanism proved to have extremely good resetting accuracy. It is able to locate precisely the required station even if it happens to be a weak one at the high frequency end of the band. The station selected for a particular button can be changed within a few seconds simply by pulling the button out fully, tuning to the station with the manual knob and then depressing the button fully.

A minor criticism is that there are a few whistles on weak stations between the locals but we are sure that this would not be a disadvantage in practice.

The receiver is manufactured by Ferris Bros. Pty. Ltd., of Sydney, and is available from most car radio suppliers. Special panels to suit the decoration of most cars are stocked. The price is 49 guineas including aerial but excluding installation.

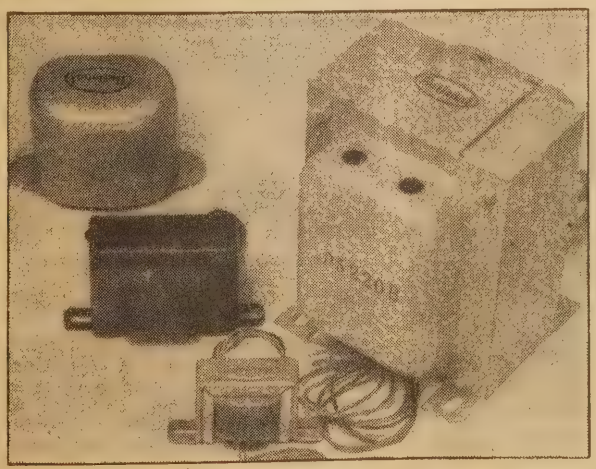


The Ferris 6 volt car radio. Heat sink for the transistor is to the right.

NATIONAL TELEVISION RECEIVER PARTS

THE largest component in the group is the power transformer which, as per specifications, is designed to deliver a filtered DC output of 260 volts at 300mA, using silicon diodes in a full-wave voltage doubling circuit. The transformer is arranged for vertical mounting in the space provided on the chassis and carries a magnetic shield.

Companion item to the transformer is a filter choke which, while inexpensive, carries ratings which are within those published.



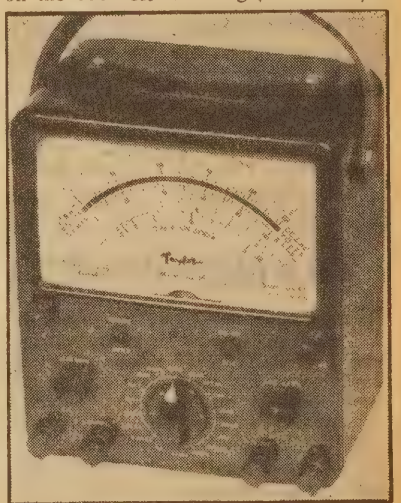
Left: These four National components have been designed for the R, TV & H. 21in Television receiver. The power transformer is at the right, the speaker transformer is at the rear, the power choke and the blocking oscillator transformer in front.

Right: The large open mirror scale of the Taylor 100A meter makes for easy and accurate reading. An automatic cut-out protects the movement in case of overload.

100,000 OPV METER

WIRE of a special alloy which can be drawn to extremely small diameter permits the construction of a meter movement which requires only 8 uA for full scale deflection. This movement is used in the Taylor 100A Multi-Range Meter which has a sensitivity of 100,000 ohms per volt on all DC ranges and 5,000 ohms per volt on the AC ranges.

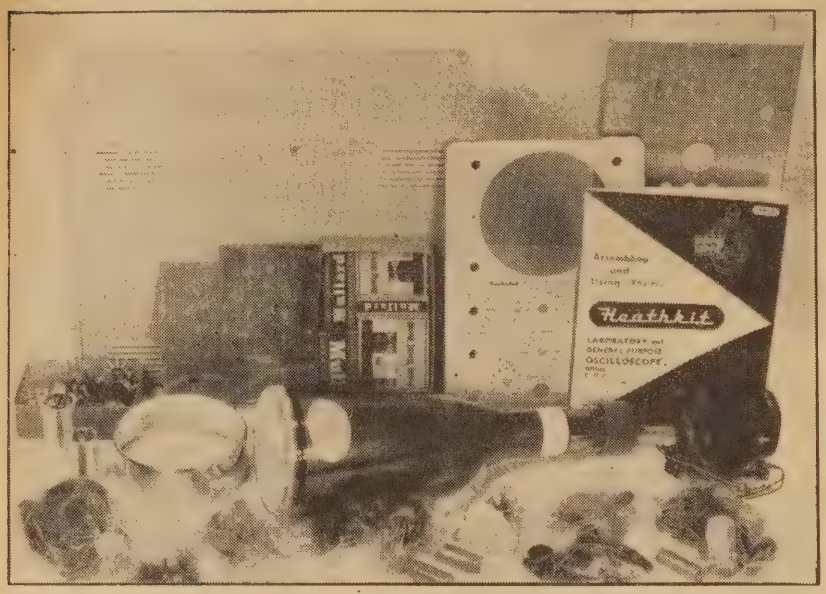
Internal resistance of the instrument on the 100 volt DC range, for example, is 10 megohms. This is comparable with a valve voltmeter.



Accuracy is 2 per cent of full scale deflection on DC, 3 per cent on AC.

The price is £59/5/ plus tax where applicable and the Australian distributors are Jacoby, Mitchell and Co., P/L, 469 Kent Street, Sydney.

HEATHKIT OSCILLOSCOPE PARTS



There are so many parts in the kit that it is difficult to show them in the one photograph. This is not the full complement!

The Heathkit Laboratory and General Purpose Oscilloscope Model 0-12-U is now being imported into this country by Warburton Franki Industries (Melbourne) Pty. Ltd. A first grade instrument in kit form, the 0-12-U has an overall vertical frequency response within 1 db of reference between 8 cps and 2.5 Mc and only 2.2 db down at 3.58 Mc.

THE amount of effort that has gone into the planning of the kit and assembly of the components is appreciated even before all the components are unpacked. Even small items such as nuts and bolts, terminals, knobs and solder are carefully sorted and packaged so that there is little danger of them being mislaid.

No components additional to those in the kit are required to complete the instrument. There are no holes to be drilled and no mechanical work to be done apart from simple assemblies with hand tools. The tools you will use most in assembling the kit are a soldering iron, a screwdriver and a pair of long-nosed pliers with few others needed.

Wiring problems are minimised by the inclusion of a prefabricated wiring form while two printed wiring boards ensure standardised performance and remove the tedium of much of the detailed wiring.

The 50-page instruction manual is a model of how an instruction manual should be produced. Circuits, photographs and line drawings of various sub-assemblies are included making it a simple matter to complete the oscilloscope exactly as the designers intended.

The manual features a step-by-step assembly list covering every detail of the instrument.

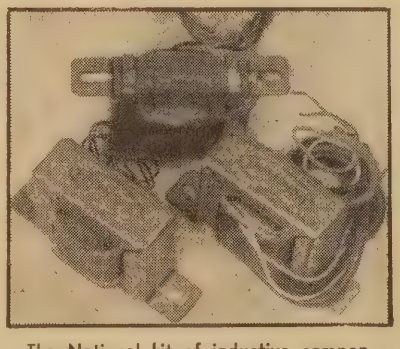
The kit is available ex-stock at £62/10/ plus 12½ per cent sales tax, F.O.B. Melbourne.

Information on other Heathkits will be supplied on request.

TRANSFORMERS FOR 1959 KARSET

NATIONAL TRANSFORMERS P/L have submitted a set of transformers and a choke for 1959 Karset which was described in the June issue. These have been tried in the laboratory model of the receiver and have been found to conform to the required specifications.

The driver transformer used to couple from the collector of the TS3-Z to the base of the 2N250 is designated type LLA8000/20, the output transformer LLA20/3.5, FB, and the low tension choke LLA.02/1100. Overall dimensions, excluding lugs, of all three items are approx. 1½in by 1¼in by 1in. All are wound on grain oriented steel laminations. Retail price is 21/6 for each item.



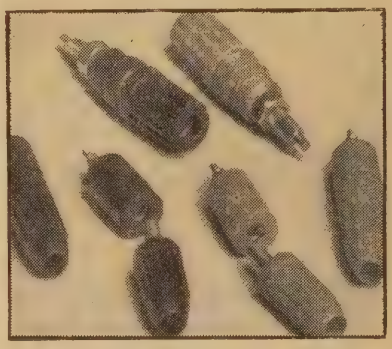
The National kit of inductive components for our 1959 Karset.

TERMINALS, PLUGS AND SOCKETS

IN the past experimenters have had difficulty in obtaining suitable terminals for home constructed instruments and so on. A recent release of terminals, banana plugs and banana plug sockets under the Jabel name will therefore be very welcome.

The samples submitted were well made and should stand up to normal use without difficulty.

The terminal is of the instrument type



The new Jabel components.

capable of taking a round wire, spade terminal or a banana plug. Ordinary hook-up wire can therefore be used in a semi-permanent test arrangement or the test prod, lead and plug combination conveniently used for quick checks. It is suitable for panels up to 3/8in thick.

Where it is not necessary to make connection with ordinary round wires or spade terminals, the banana plug socket is cheaper and smaller.

The banana plugs are so designed that connection can be made with or without solder.

All three items are available in either red or black. The trade prices are: terminals 4/8, banana plugs 2/8, and banana plug sockets 1/8. Prices are for a single item and do not include tax.

POWER RECTIFIERS

THE Raytheon 1N1763/CK935 is a diffused silicon rectifier intended to be used for power rectification in television receivers. Two of these in a voltage doubler circuit eliminate the normal valve rectifier and permit a smaller

Raytheon 1N1763 silicon rectifiers.

power transformer and hence a smaller and lighter television receiver.

Samples, submitted by Electronic Industries Imports P/L, of 121 Crown Street, East Sydney, were tried in our current 21in television receiver and proved perfectly satisfactory. The retail price is 21/10 and supplies are available from stock.

TECHNICAL BOOK REVIEW

MULLARD REPRINT

MULLARD CIRCUITS FOR AUDIO AMPLIFIERS, Mullard Ltd., London. Australian copies from Mullard Australia Pty. Ltd., 35 Clarence Street, Sydney. Soft cover, 136 pages, 10in x 8in. Illustrated with circuits, graphs and photographs.

Since 1954, the Mullard Co. has issued a succession of amplifier designs for a wide variety of audio equipment. These include main amplifiers, pre-amplifiers, tape amplifiers, and, most recently, stereo amplifiers.

These have been issued in a variety of forms, while others, most recently developed, have yet to be released. This book was published for the purpose of collecting all these into one volume, including the latest circuits mentioned above.

The first 25 pages of the book are devoted to articles of a general nature, including such subjects as Amplifying Systems, Sources of Distortion in Recorded Sound, and High Quality Amplification. There is also a small chapter on construction and assembly in the general sense as applied to amplifiers.

This is followed by the detailed description of 11 projects, including amplifiers, pre-amplifiers, tape amplifiers, and stereo amplifiers. Between them they should cover most of the requirements of the audio enthusiast.

Each article is most comprehensive, including circuit, detailed parts list (with lengthy specifications where these appear to be justified), chassis drawings, photographs, assembly diagrams, and performance data. Anyone with any electronic building experience at all should have no difficulty in following these instructions.

Included in the Australian issue will be two pamphlets describing the Mullard Stereo 7 and Mullard Stereo 2 amplifiers. These are particularly suited to local marketing conditions.

It should be noted that our copy was an advance sample, and that Mullard Australia Pty. Ltd. do not expect to have full stocks for several weeks after this appears in print. The exact price has not been fixed, but is expected to be in the vicinity of 12/6.—**P.G.W.**

★ ★ ★

SINGLE SIDEBAND

FUNDAMENTALS OF SINGLE SIDEBAND, Collins Radio Company, Cedar Rapids, Iowa U.S.A. (Australian Representatives: Electronic Industries Ltd., 126 Grant Street, South Melbourne, Vic.). Soft cover, 240 pages, 11in by 8½in. Illustrated mainly by circuits, graphs and tables.

The Collins Radio Co. has been very active in the design of single sideband equipment in America and this volume is, no doubt, part of the result of their experience in this field.

SSB is mainly used for long distance communication and although it is very much more complicated than AM or FM equipment the bandwidth required is less than half that for AM and the weight and size for effective communication also very much less. SSB has advantages over narrow band FM, particularly under weak signal conditions.

The complication of SSB systems is due to the need for extreme frequency stability at both the transmitter and the receiver and also the need for filters meeting extremely rigid selectivity requirements.

The book begins with a general introduction explaining the nature of the single sideband signal, a comparison with other systems and leads on to the theory of various aspects of single sideband. Individual chapters are headed, "Single Sideband Exciters," "Single-Sideband Receivers," "Stabilised Master Oscillators," "Frequency Standards," "Power Amplifiers" while a number of other chapters deal with ancillary topics.

The book is directed at professional communication engineers but would be of value to many of the advanced amateurs who are experimenting with SSB techniques at the present time. (M.V.F.)

MODEL CONTROL

MODEL RADIO CONTROL, by Edward L. Stafford, Jr., Gernsback Library. Soft cover, 192 pages, 8¼in x 5¼in. Illustrated with circuits, diagrams and photographs.

In spite of the rather generous flow of books on this subject, there appears to be plenty of room for one more, and anyone interested in this subject will find this a very useful reference.

The first chapter is devoted to Basic Concepts, followed by Coding and Coders, Transmission (dealing with various types of radio transmitters), Receivers and Decoders.

The latter half of the book deals with the more complex aspect of control systems, such as servo motors, power control, transistors, finishing with details of practical transmitters and receivers, and the construction of coders and decoders. We imagine that this part of the book would appeal particularly to those who, having tried some simple circuit, were keen to advance their knowledge.

Our copy direct from the publishers. No Australian price is available.

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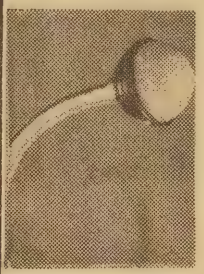
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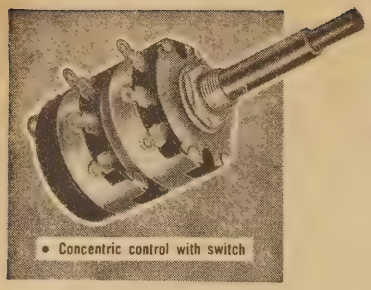
• Concentric control with switch

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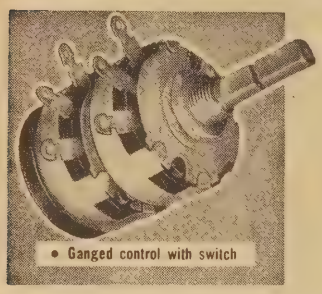
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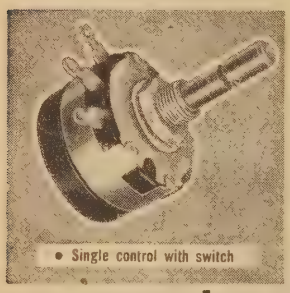
• Single control with switch

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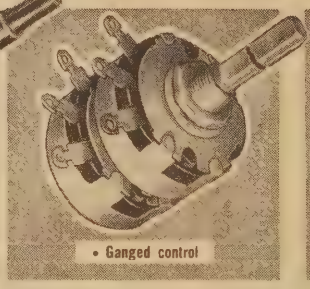
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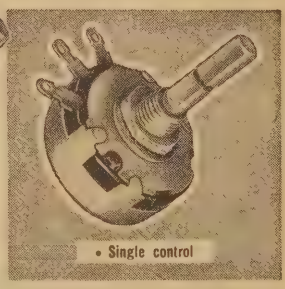
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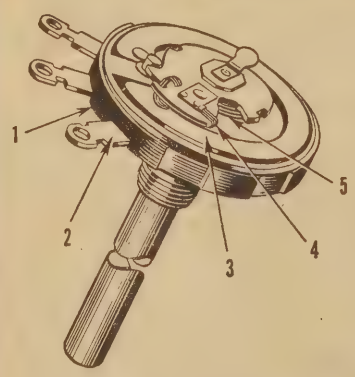

1 **The IRC control base** is precision-moulded of high-strength, low-moisture-absorption bakelite. This ensures that other parts remain accurately aligned

2 **Terminating lugs** are all heavily plated for ease of soldering and positive connection to the element is ensured by riveting. The riveted lugs, unlike pressure-contact types, will not loosen with soldering and the terminals may be bent for wiring to any convenient position without the control becoming noisy.

3 **Resistance element** of metallised coating bonded to bakelite is cured and seasoned at high temperatures. The result is a smooth, low-noise-level element, extremely hard and resistant to humidity and ageing effects. The flat strip principle enables the production of elements which conform more closely to the eight published curves than is possible with solid carbon tracks. By virtue of the physical size, the CS element therefore has a greater power dissipation with lower temperature rise than with other types.

4 **Multiple finger contactor** consists of five silver plated phosphor-bronze springs which are independent of each other and have a "knee action" effect as they move over the element surface. The contact pressure of each spring is accurately adjusted to give correct pressure on the element for minimum noise level consistent with long life.

5 **The silent spiral** is exclusive to IRC and it provides for permanently noiseless low-resistance connection between the centre terminal and contact fingers as they move over the element. The spiral replaces the conventional collector-ring connector which has been the main generating source of rotational noise in other controls.

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Here's your answer, Tom!

A number of straightforward queries of an evergreen nature, together with an enlargement of a query from last month's issue make up this month's bag. Remembering that similar problems bothered us when we were beginners, we can readily sympathise with Tom's dilemmas.

IS it possible to modify a transistor radio to receive on long wave? Why do we not hear anything about long wave in Australia?

The term long wave, Tom, is synonymous for low-frequency wave-length which describes radio waves between the frequency limits of 30 and 300 Kc. These frequencies lie below the broadcast band which is termed the medium-wave band.

It should be possible to modify a transistor radio to receive the lower frequencies, but it is unlikely that coils covering this band would be readily available.

Moreover, if you were able to overcome the problem of the coils, the modification would be of doubtful value.

Although a few overseas stations still use the long wave band, in Australia this band is mainly used by shipping. Much of the communication would be by Morse and in code, leaving little of value to the average listener.

★ ★ ★

I have just built a superhet receiver which works very well on local stations, but I have found that the weaker stations are drowned by a "birdie" in the background. Could you please tell me how to dispose of this birdie?

We could make a number of facetious suggestions on the use of the catapult, pea rifle or scarecrow, Tom, but we feel certain that in the circumstances these would not be appreciated. You may rest assured though that your problem is not an unusual one, for set designers and set builders have been plagued by it from the early days of radio and will continue to be plagued as long as the superhet stays with us.

It would be difficult to explain "birdies" technically without going into a mass of calculations.

To begin with, "birdies" are those odd little whistles which appear as one tunes across certain stations. They are quite distinct from the strong whistle, produced when the set is oscillating. It appears that most "birdies" are the result of cross-modulation effects in the first valve, particularly if it happens to be a converter.

The first requirement, therefore, is to use the most efficient possible aerial coil, one that has a high "Q" and moderate coupling only between primary and secondary. See that the circuit tracks properly so that, as far as possible, the only signal of any magnitude fed to the converter grid is the desired one.

Check the operating conditions of the converter to make sure that all the potentials and especially the oscillator grid current check up with the recommended ratings.

Keep the aerial terminal and lead clear of the IF channel and avoid using an excessively long aerial for local station reception.

Birdies are most likely to be present when strong local stations are on the air. This is borne out by the fact that, you will often notice, they disappear when one or more of the local stations have closed down. Distant stations may then be heard clearly without a trace of a heterodyne whistle.

★ ★ ★

Do short-wave or dual-wave sets have world range? If not, what is a good indication?

Well, Tom, it is rather difficult to be specific about range since, under the best conditions it is possible to receive stations from the other side of the world on a one-valve set. You see, so much depends on location, atmospheric conditions, the aerial and earth systems, and the care with which the set is adjusted and operated. All we can do is make a few general statements and we will commence with the broadcast band.

"I'll say he's new!"

Broadly speaking, one-valve and two-valve reaction sets may be relied upon to give good earphone listening over a range of from say 30 to 100 miles, assuming that you use a good aerial and earth system. Adding a third valve could give you loudspeaker results up to 70 or 80 miles and interstate reception on earphones.

Reaction sets, however need a good deal of care to operate, and non-technical users often succeed only in making them squeal and interfere with neighbouring receivers.

For simple operation, it is really necessary to go to the superhet circuit, which is the reason why they are employed universally in Australian homes.

A four-valve superhet will usually give daylight reception of up to 100 miles, and interstate reception at night. For still better results, it is desirable to have a superhet with an RF stage. This will call for an extra valve.

All the above said refers to the broadcast band only. On short waves it is impossible to speak of range, since stations from half-way round the world can be louder under certain conditions than stations 100 miles away. It depends on the time of day or night, season of the year, the frequency or wave-length of transmission, and the location of transmitter and receiver. If you want guidance on the matter we can do no better than refer you to the short-wave page in this magazine.

Nevertheless, our remarks about reaction and superhet receivers still hold good. A one or two-valve reaction set is usually good for earphone reception, while a three-valve reaction set will bring stations in on a loudspeaker if carefully adjusted. Superhet receivers are always easier to tune, a four-valve set being mediocre in its performance, and a set with an RF stage being a much better proposition.

★ ★ ★

I have a query for which I couldn't find an answer in any books. Does it make any difference if coils, such as the final tank coil of a transmitter, are wound on formers instead of space wound?

The answer to this one, Tom, must be prefaced by the phrase "it all depends." For that's exactly the position.

It depends on frequency. As the operating frequency is increased it becomes more and more important to pay attention to this matter, since losses are more likely to occur at the higher frequencies.

It depends, too, on the material you wish to use for the former. Some materials are very poor, others are so good that they have no detrimental effects whatever on the coil.

Finally, it depends on the power involved in the circuit. If the combination of power and the losses are sufficient to cause heating of the material, the chances are that it will steadily

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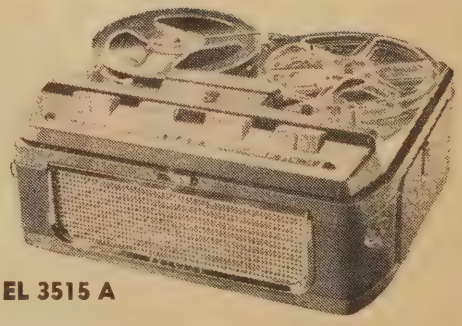

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deteriorate with use, with an obvious result.

Having given you the generalities, we can now discuss the subject more thoroughly. Referring firstly to receivers, a broadcast coil can be wound successfully on almost any type of former, from cardboard mailing tube to special low loss materials. The difference in performance will not be noticeable in the average receiver.

For a short-wave receiver it is wise to avoid untreated cardboard, which is likely to be poor mechanically as well as electrically. Suitable materials are bakelised cardboard, bakelite, trolitul, polysterene and ceramic. For the frequencies below 30 or so megacycles the differences between them are not very marked.

Above 30 Mc it is wise to be more careful, using, for preference, only trolitul, polysterene, ceramic and the best quality bakelite materials. From about 70 Mc onwards, materials such as trolitul, polysterene and ceramic should be employed.

However, at these high frequencies it is often possible to dispense with the former altogether. Thick wire is used for the coils and it is possible to make them self supporting and rigid. Former losses then do not come in to it.

From an electrical viewpoint, the difference between a self-supporting coil and one wound on a low-loss former is negligible.

In a transmitter, the position is always more critical, in that a considerable amount of power is present in the tuned circuit, as also are high peak voltages. An inferior former may heat up and blister, with resultant distortion of the coil. These losses are likely to increase as the former deteriorates further.

In a transmitter, therefore, it is wise to restrict the use of bakelite and cardboard formers to plate coils carrying only a few watts and at frequencies lower than approximately 15 Mc.

For higher operating frequencies and power, it is wise to use formers of materials known to have good high frequency characteristics. If the final tank coils can be made self supporting, it is a good idea to use this method, thus saving any worries there may be about former materials.

★ ★ ★

Electrons are pulled by magnets. Therefore if the plate of a valve was magnetised you would not need so much current.

We're afraid it wouldn't work out that way, Tom. The prime action of a magnetic field is to bend or deflect a beam of electrons from a particular path and use of this fact is made of in modern cathode-ray tubes. The electrons are accelerated and attracted by electrostatic charges but deflected by magnetic fields.

Your statement about saving current is also suspect. Electron flow is current flow and you can't increase one without increasing the other. Maybe you had in mind that your scheme would have allowed the same electron flow with fewer volts applied to the plate or less power to heat the filament or cathode.

This would correct terminology, Tom, but doesn't alter the basic answer.

And now for a letter from a reader whose query was answered in the July issue. It appears that he is dissatisfied with the answer and wishes us to enlarge on it. The question as presented to us read, "Why and what is the anode-to-grid feedback of a triode amplifier?" He now adds:

One of the early things one learns when studying valves, it that plate-to-grid feedback causes instability and high frequency losses in triodes. It is then explained as you have done, so that I and, I guess, 90 per cent of your readers, know that much.

I am mainly interested in the circuit path external to the valve. I wanted you to draw a circuit and explain all that happens, with current and/or voltage directions indicated, and why, over one cycle of voltages, due to anode-to-grid capacitance.

The answer to your query, Tom, was given as we saw it. However, we do not mind enlarging on it, if it will help you in grasping the action.

First and foremost, plate-grid capacitance produces its (usually) unwanted effects, irrespective of where the capacitance occurs. It can be within the electrode structure, between leads inside the valve base, in the socket or between wires and components connected to the plate and grid pins. All such capacitance is in parallel and produces a certain total effect.

Consider this effect, for example in a valve acting as a resistance-coupled audio amplifier.

If the plate of the valve were simply an electrically inert piece of metal, the input circuit would be loaded by an apparent capacitor equal in value to the actual capacitance between grid and plate.

But the plate isn't inert. If the stage has a gain of 20 times, for example, a one-volt RMS signal on the grid would produce an out-of-phase 20 volts RMS on the plate, thus creating a difference of 21 volts RMS between the two. The capacitive current which flows would be 21 times as great as normal so that, in other words, the capacitance looks like 21 times its actual value.

As we said earlier, Tom, this actual value is the sum of the internal and external capacitances. The former can be controlled by selectig suitable valve types; the latter involves taking care with wiring and component layout.

★ ★ ★

Can you please tell me what the term "umhos" stands for? I have often seen it in articles and valve data books.

The first letter, Tom, is not the letter "u" but an attempt to simulate the Greek letter "mu," which looks like our "u" with a tail. The expression may be written in full and pronounced as "micromhos." As such, it expresses the transconductance or mutual conductance of a valve.

You may, or may not, know the meaning of transconductance. It is, fundamentally, the ratio between a small change of plate current of a valve to the grid voltage which caused the change, all other potentials remaining fixed. This is expressed in terms of milliamps per volt.

The expression you are in doubt about is obtained by multiplying the number of milliamps per volt by 1,000 and calling the result "micromhos." Thus, a valve having a transconductance of 3 milliamps per volt—3mA/V—can be said to have a mutual conductance of 3,000 micromhos. Conversely, a valve with a transconductance of, say, 6,000 micromhos, can be said to have a transconductance of 6mA/V.

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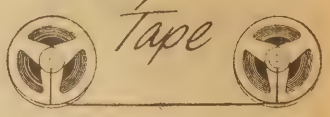

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Let's Buy An Argument

Once every month, I face the task of writing these columns. Since it is largely a self-appointed one, I can hardly growl if what I say does, in fact, "Buy An Argument". But I'm not so happy about having arguments bought for me on the strength of an implication I did not make.

by Neville Williams

WHAT prompts this remark is an article in a recent issue of "TV News-Times," where I am reported in an article as saying, and I quote the actual paragraph:

"If you asked servicemen to show you their qualifications, I doubt if many could produce anything at all," said Neville Williams, technical editor of "Radio, Television and Hobbies" magazine, and a member of the Australian Institute of Radio Engineers.

UNCHARITABLE HOPE

It may seem uncharitable but I hope that not too many servicemen read this article. If they did, I can't blame them altogether for saying, "You stinker!" or less polite words to the same effect.

Whether I said the exact words and in the exact order quoted is not the point of my objection. Rather is it that they —or their equivalent—formed only a small part of an informal chat over the phone and, divorced from their context, they carry an inference which is quite different from what was intended.

In saying this, I'm not trying to pull the old trick of seeming to run with the hare while simultaneously hunting with the hounds. I'm merely seeking to clarify my position in respect to the said exercise. If you don't like it, you are perfectly free to write in and say as much. The pen is mightier than the sward.

(I hope that the proof readers don't "correct" that last word.)

It all stemmed from a question which as near as I can remember, was: "Do you know of any move that is being made to licence television or radio servicemen?"

In answer to this question, the points I made (very carefully, by the way) could be summarised as follows:

1. The idea of licensing radio (or television) servicemen has been put forward at various times by various people for the past 20 years or more, but, in New South Wales at least, such ideas have thus far not come to fruition.

2. In considering the problem it is necessary to remember that a person does not automatically become a good radio or TV serviceman the day he receives a certificate from a technical training school. Before he can work quickly and efficiently he must have become familiar with the tricks and troubles—both mechanical and electrical—of all the makes and models which he is likely to encounter.

MANY ARE PROFICIENT

3. While some so-called servicemen are obviously unskilled and, in some cases, dishonest, a great many others have become very familiar with receivers of all makes and models and are proficient at recognising and rectifying troubles in them—yet such men may have no official academic qualifications.

4. It would be ridiculous to prohibit these men from continuing at the trade in which they have become proficient. They would have to be granted a licence; but so also would many others who could claim current employment or experience in the field, even though they lacked initiative, honesty, courtesy, appearance and most of the other characteristics one might consider desirable.

5. Because of the above, licensing of servicemen could offer no immediate solution to the problems which are currently facing the television industry and insurance companies connected therewith. A complete generation would have to pass before all servicemen could boast an accepted trade certificate.

Those are my views on the subject based, I hope, on commonsense and on a good many years of experience of servicing, prior to entering technical journalism. To quote just one half of the thought sequence expressed in my paragraph 3 puts an entirely different slant on my remarks.

BECOMES AN ATTACK

What was offered as an analysis of a position becomes an unqualified attack on servicemen.

I seem to recognise the paragraph in "TV News-Times," which immediately precedes the one in question. If this had been included in the quote marks, I would have been quite happy, because it would restore the original inference.

It reads:

TV SERVICE — LONDON OPINION

"But much of a TV mechanic's knowledge doesn't come from books. Years in the field are necessary before the serviceman can recognise faults and know immediately where to look for the trouble."

Enough said. I think the record has duly been put straight.

In the meantime, a letter to hand from a former London TV serviceman makes very interesting reading and pretty solidly backs up the opinions and misgivings expressed in earlier articles. He, too, maintains that insurance schemes are doomed to failure, unless operated by firms employing their own service staff.

The interesting point is that this is based on actual experience in London, where a system of licensing operates — though how effectively I don't know.

HUGE LOSSES?

Another intriguing point is how local insurance companies, who must have known of this general background, walked right into contracts and arrangements which have allegedly lost them hundreds of thousands of pounds.

Maybe it's just that such a figure just sounds a lot more to me than it does to them.

The figures quoted for premiums are enlightening and also rather alarming. Assuming that they are sterling, 5/ per week or £13 per year becomes a very impressive sum, when upgraded by the exchange rate and relative wage and price levels to Australian conditions.

Even so, says our correspondent, this assumes that many picture tubes are reconditioned at low cost, not replaced with new ones.

This question of reconditioning tubes has been raised locally on many occasions and, in my hearing anyway, deprecated in a very loud voice by picture tube manufacturers.

By the time we do this and that, they say, we save very little. We may just as well sell a new tube which can properly and rightly be guaranteed. We're really doing our clients a service by NOT repairing their tubes.

I wonder? Most propositions can look very attractive if one starts off feeling that way.

WHY BOTHER?

If you have a nice business making and selling new tubes, it can only "muss it up," having to worry about reconditioning old ones. Some of the plant and staff would have to be diverted to the new task; they'd have to learn new tricks; a whole lot of new book work would have to be set up; and so on ad nauseum.

But how is it that reconditioning can apparently be done so economically overseas? Our correspondent says that he worked in a firm where it was done for £2 per tube.

If this is anything like a fair statement of fact, imagine the incentive or (for the lack of it) buy a new one. Come to think of it, a lot of Australians run their motor cars on tyres recapped for a much less spectacular saving in capital cost.

Is that what the local valve manufacturers are afraid of? Is that why they look so horribly disdainful?

Is there a spare valve factory in the house? It might be worth buying up.

Of course, the habit of reconditioning picture tubes can have ramifications in other quarters and lead to the slopping of many official cups of tea, held in trembling Public Service fingers.

TAXATION PROBLEM

As has happened in England, it becomes necessary to decide whether a reconditioned tube is merely a second-hand item returned for repair or is, in fact, a "new" tube, subject to the usual and very considerable sales tax.

You can imagine the arguments ranging from "obviously a repair" through "new product content" to "just a means of evading tax." On this latter point, it may be economical to "repair" a picture tube, even though it involves complete replacement of all parts!

But one thing appeals to me as a "see Naples and die" kind of experience. That would be to hear a solemn conclave of Public servants debating whether or not the vacuum in a repaired picture tube was the original vacuum or a completely new one!

Let me pause for a moment to drool.

Changing the subject slightly, there's one aspect of television servicing which certainly doesn't call for drolling. It was brought to my notice by a technically qualified friend, who had occasion to observe the modus operandi of a small but well established radio and television dealer in his district.

REPLACES TUNERS

Apparently this dealer gets his share of troublesome tuners but adopts the policy of not attempting to fix any but obvious faults. Instead, they are removed from the receiver and replaced by a new or a reconditioned tuner and the set put back immediately into service.

But here's the rub: The changeover may be effected in the client's lounge-room or in the service shop but, whatever the locale, no attempt is made to check on the alignment. If a picture

---

Dear Sir,

I arrived recently in Australia to swell the ranks of qualified Television Servicemen in S.A. and I note with interest your article concerning Television Insurance Schemes.

After seven years with two leading London Television Maintenance companies, let me assure you that Insurance Schemes offered by companies not employing their own Service staff are doomed to failure. Several such schemes were introduced in 1947-48 but only one remains and this company now has its own Service depots.

Maintenance Schemes replaced the Insurance schemes (there being slight legal differences). These are all-in schemes commencing from 2/6 per week (£6/10/- per annum) for sets registered on the date of purchase (or within seven days thereof) to 5/- per week (£13 per annum) for sets over 18 months old. Sets over two years old before registration could not be accepted. Extra is charged for sets incorporating radio and/or gram units.

The Maintenance Scheme contract varies from company to company but loosely states that the company undertakes to repair or replace any faulty components and maintain the receiver in reasonable working order until, either payments are discontinued or spares cease to be available from the makers.

This means that sets up to about ten years old still pass through the workshops but five years is a good average life for most receivers. They become superseded by larger screens, better circuitry etc., but some 10-inch one-channel T.R.F. receivers of the HMV 1807A type are in daily use. These appear in the works frequently for all manner of faults, especially C.R.T. failure.

Picture tubes have an average life of 3 years and anyone purchasing a receiver must budget for a £40-£50 replacement bill within 3 years (excluding any other minor repairs in the meantime). This means that an Australian maintenance scheme cannot cost less than £15 per annum or the company will become bankrupt.

To retain the lowest weekly, monthly or yearly charges it is essential that the Maintenance company establishes good relations with all manufacturers to obtain spares and also a source of reconditioned picture tubes must be available.

My old company carried out the complete reconditioning process in their own works, which involved the same vacuum processes as during manufacture and cost only £2 per C.R.T.

Each service call, of which we handled 100 daily with an outside staff of ten engineers, cost on an average 12/6d, excluding any components used and about 18 sets per day passed through the workshop with a staff of two engineers and two apprentices. This was for a total of 18,000 contract customers in the Greater London area only.

I shall be interested to watch developments but I will now stick my neck out and predict that, by 1961, all-in maintenance schemes will be operated in S.A. by companies having no retail outlets. They will accept any receiver that is in full working order and fulfilling the age requirements laid down.

This will free the smaller retailer from the burden of a non-profit making TV Service Depot (he will still retain the Radio service) and provide the receiver owner with a reliable service at a reasonable cost.

Yours faithfully,
R.R.

P.S. I hold the City and Guilds of London Institute Certificate in Radio and Television Servicing, dated 1949 and 1950 respectively.

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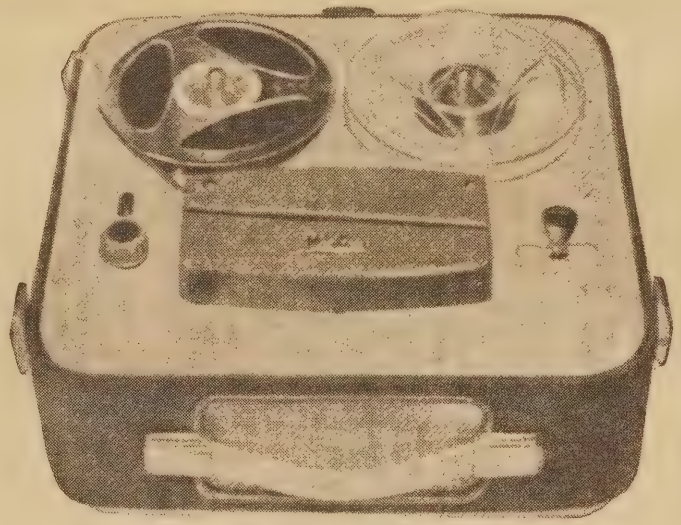

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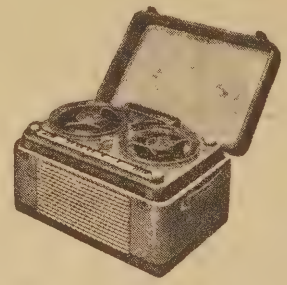

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appears on the screen, the set is considered as "fixed."

I mentioned the fact to another friend who has some connection with the service game. "That's right," he said, "the fellow at —— does exactly that"—mentioning another suburb.

Oh, brother!

The relative settings of the slugs in the tuner output and IF input circuits are most important to the overall shape of the response curve and the result of a random combination could be almost anything.

Add to this the influence of occasional replacement valves and other repairs, particularly in the IF channel, of vibration and the passage of time and it is quite inevitable that the ultimate response curve will bear simply no resemblance to the intended optimum.

SHOWS UP

And it can certainly show up in the behaviour of the set. Instead of optimum picture occurring adjacent to the sound-bar setting of the "Fine Tune" control, it may occur where the sound level is weak; or the picture quality may be so bad that it can scarcely be considered to occur at all!

Many dealers argue that alignment is much too time-consuming and much too difficult to attempt in all but the last resort; that the customer's main concern is to "get a picture."

Maybe those statements are true up to a point but I must quarrel with the idea that seems to hold in some quarters that a serviceman's job is to fix faults—and let the alignment go hang.

The foregoing remarks were written on a Friday. This is Monday and, in the meantime, I have coincidentally encountered at first hand a shocking example of how bad things can get.

An acquaintance who has his own reasons for not wanting to instal a television receiver permanently, had equally good reasons to hire one for a month. I don't know all the details, but a 17in table model duly appeared in his home, complete with an indoor "rabbit-ear" type aerial.

FIRST REPORT

The first I heard was that the set would not receive Channel 2, the picture being very weak and being described as "just like a sort of outline."

Since it was in a good signal area, I simply assumed that it was the old story of a set being dumped into a house and no attempt made to check the setting of the oscillator slug. A touch to shift the range of the "Fine Tune" control would therefore be all that was necessary.

No such luck. Channel 2 was indeed weak, but the other channels were not much better. And the picture quality was the worst I have ever seen. Likewise the sound.

Gain was low and the picture had a certain "soot and whitewash" quality that defied for correction any manipulation of the contrast, brightness and AGC controls. Even after setting the oscillator slugs, the fine tune control afforded a choice between outlines with no blacks, or a black smear with no outlines. And I mean no outlines!

At no setting was the picture even remotely satisfactory. It was so indistinct that well-known characters on the screen could not be recognised visually. They had to be identified by voice.

The sound itself was heavily loaded with intercarrier buzz and highly distorted. Quite obviously, the ratio detector transformer was a long way out of adjustment.

In other words, the whole receiver was in shocking need of repair and adjustment, yet it had been delivered in that condition to a client for rental.

At my suggestion that he ring immediately and demand satisfaction, my friend was anything but happy. Apparently, he was responsible for a proportion of any service charges on the set while it was in his possession. Since he had accepted delivery of the set, he could conceivably be required to subsidise what looked like an extensive service job.

To have made such demands, the firm concerned would have had to be blatant, barefaced robbers, and I expect that they will duly rectify the matter. But how on earth could anyone, with an ounce of business acumen, deliver to a client a set in that condition?

WHITE LINES

Still on television, two separate people got in touch with me after reading last month's article on "coloured" TV. Both took me to task for omitting to list yet another important "advantage" of putting tinted plastic in front of a picture tube screen.

They point out that such a device will remove the white outlines from television images.

Well, now, that's really something. So they will.

Now white outlines are very technical and very nasty things. They are sometimes due to alignment difficulties which need quite a lot of expensive gear for their correction. Or they can result from "overshoot" in the video detector or amplifier peaking circuits. Again, more equipment and more testing.

But it appears that there is a much cheaper way out and that much of this expensive gear can be scrapped. Textbooks can be re-written. Nor can I deny the truth of the claim.

Tinted plastic in front of the screen will get rid of white lines.

It turns them into pink-brown-green lines!

Last but not least, white lines can occur because of transmission difficulties, particularly on outside broadcasts. I must ring the engineers immediately and suggest that they fit their O.B. cameras with a multi-coloured monocle!

SPACE OR RADIO?

The two letters on this page illustrate the different ideas which readers have in regard to these columns. Amongst other things, R.M. obviously wants to start a discussion about space and whether it is, in fact, a misnomer.

L.M. is of a different mind and deplores too much divergence from matters immediately connected with radio and television circuitry. (There's that word again.)

With touching deference, R.M. poses the problem of light rays and asks "What is your theory?"

Why should I have a theory, when the whole question is being argued at the highest levels by people working in this field?

However, I did read with interest a recent article by Dr Butler of the Sydney University, who pointed out that

SPACE PROBLEMS OR RADIO, TV

The Technical Editor,
Dear Sir,

I would like to congratulate you on the quality of the magazine, which has been growing bigger and better all the time. I read quite a few American Radio Journals, but none of them have the same personal touch that all the articles in R, TV and H have. It is this personal touch that gives the readers confidence in your articles.

About six months ago, I built the Playmaster 9. The amplifier is good and out-performs any comparable amplifier. Working with it I have the 6AM6 FM tuner which was working fifteen minutes after turning on.

A little bit for "Let's Buy An Argument."

In your columns you often talk about light as an EM wave. Is light matter or an EM wave? To support the former, light does have mass and has been weighed, the latter is supported by the fact that light can be broken up into different wavelengths by an oil film or prism. (The two theories can be applied to all "EM waves.")

What is your theory?

(Just think—if the first theory is right, i.e., that light is matter, there can be no such thing as "space" between heavenly bodies. What are they going to call "space ships?")

Yours sincerely, R.M.

LOUDSPEAKERS

Dear Sir,

In the last copy of your magazine, you answered a correspondent who queried high impedance speakers and I noticed that, as on other occasions, you carefully worded it in a very non-committal manner.

My impression is that you have secret very worthy thoughts on the subject. I would like you to set out the advantages and disadvantages of this system, which appears to be enjoying popularity with at least one well known make of amplifier.

In conclusion, I would like to see your fine "Argument" page devoted more to radio and TV matters than some of the more abstract things which appear to have crept in recently.

Congratulations on the finest Radio Magazine in Australasia.

Yours faithfully, L.M.

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Super 8 FS/AL	13	12	4
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light rays — photons — had the character of particles and possessed both mass and velocity.

This being so, scientists are speculating quite seriously about navigating space ships using huge plastic sails, which would utilise the stream of light "particles" in much the same way that sailing ships utilise streams of air particles.

Fantastic?

Who am I to say so, even though some points about the scheme don't seem to check.

But, as R.M. says, if light is matter, then the term "space" becomes a misnomer, because the space around us is well supplied with light rays.

You may be right R.M. but I don't think the word "space" is going to be tumbled on a mere technicality. Rather than try to instal a new word, it will probably be a lot simpler to let the old one acquire a new shade of meaning. After all, it's happened a lot in our language.

SPEAKER IMPEDANCE

Our second correspondent, L.M., remarks that I have replied always in a "non-committal" manner on the subject of high impedance voice-coil speakers. That may be true, L.M. but not for any subtle reason.

The question of whether a speaker has or has not a high-impedance voice coil has only secondary bearing on its quality of reproduction. Therefore, while the release of one or two high-impedance speakers is interesting, it does not mean that such speakers will necessarily outdate or outperform the more conventional types.

The chances are that, for entirely different reasons, many expensive conventional speakers will be better than the specialised types and will still be preferred, along with the conventional amplifiers to go with them. There would be no point whatever in building a new type of amplifier, just for the privilege of using a speaker which may be inferior to something already on hand.

But should high-impedance speakers begin to appear on the market in a variety and to a quality standard comparable with or better than present types, they would have to be considered very seriously, along with relevant amplifier techniques.

This situation has not yet arisen and speaker manufacturers have not got much past the assumption that their models could be duplicated in high-impedance voice coil types. Maybe they are waiting for a demand to build up from a market which is waiting in turn for speakers to be released.

By the same token, there is much talk about new types of amplifiers, with claims ranging from "better" to merely "cheaper." But it takes time to assess the practicability of new circuit systems — whether they are as claimed or are fraught, rather, with unforeseen disadvantages.

We simply have not had time to demonstrate to our own satisfaction many important points about these new techniques, nor is there any urgent incentive to drop everything else in order to do so. In the circumstances, we cannot be anything else but non-committal.

If these techniques are adopted on a world-wide scale, it will be by a process of evolution, not revolution.

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Note: "T" denotes upper half track, "L" lower half track, all others full track (except H4 and EH4, which are half track).
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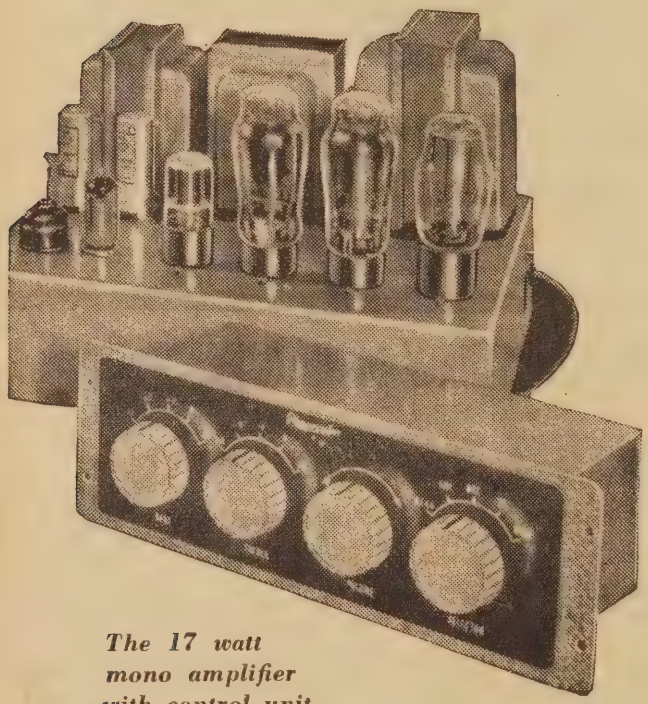

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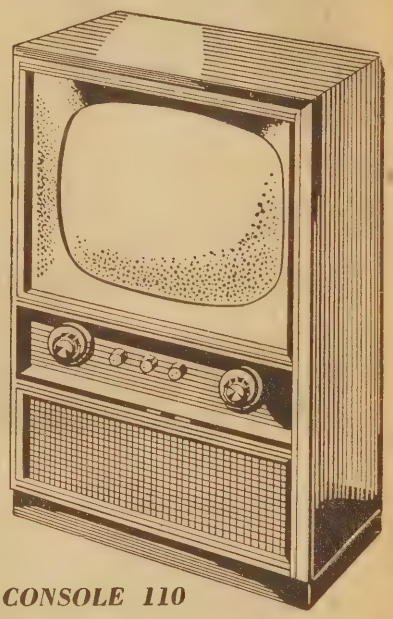

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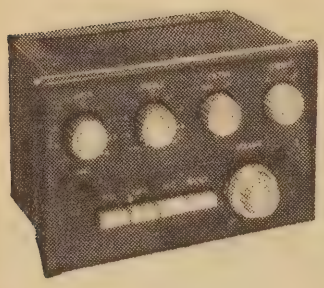

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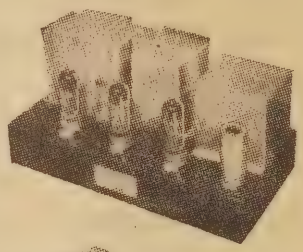

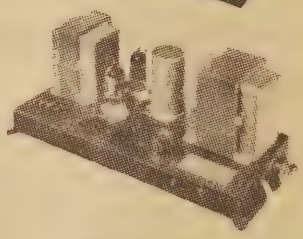

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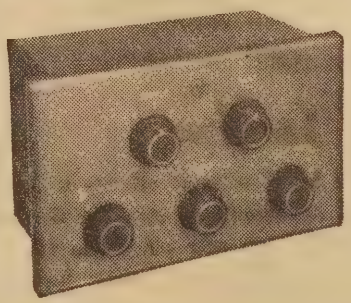

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OFF THE RECORD — NEWS & REVIEWS

When stereo records were first mooted, I well remember hearing, and to some extent sharing, the many doubts as to whether they were in fact past the optimum standard we could expect to use in the home without running into insuperable problems of wear, handling and quality.

by John Moyle

THE same thing was said about the LP when it first appeared. How would it stand up to frequent playings? How durable would be these fine stylus points, and how easy would it be to smash them? Would the problems of good quality and low noise level be overcome? Was stereo just a flash in the pan or were these difficulties merely a passing phase in the march of progress?

I don't know what you think, but I believe the LP disc, as we have known it for the last 10 years, is a much more satisfactory article in every way than its ancient ancestor.

MODEST QUALITY

It's quite true that the early samples weren't much better to listen to than the best of the 78's. Surface noise was a constant nuisance, distortion in the highs was often noticeable, and their main virtue, as it always has been, was that we heard music without interruption. This soon showed us that our old ideas on changing sides every four or five minutes was one of the miracles of stamina we all possess when we want something badly enough.

I think the same story is now emerging in the stereo field, and I am equally sure that the record manufacturers, despite their early troubles, are just as confident now as they were then that eventually the stereo disc will no longer be regarded as a hazardous undertaking.

The poor quality record player, with its heavy playing weight and easily worn jut stylus, will always be a destroyer of records and quality, but, given reasonable equipment, I don't foresee any more difficulties in the future with stereo than there were with the LP.

I now have records which have been played more times than I can count, and, with a variety of pickups—all adjusted, it is true, so that they were free from faults which would amount to downright abuse.

NO EVIDENT WEAR

They are all playable with substantially their original quality, and none of them shows any perceptible evidence of wear.

It's not very realistic to count up the number of possible playings which theory seems to allow, and assume that hard-earned money will be dissipated when 30 or 40 playings have passed under the stylus.

I wonder if you realise how long it will take you to get through that many? Given a reasonable library of, say, 30 records, and playing each one twice a week, work out for yourself how long you can expect your records to last.

Unless you are a type who spends several evenings a week doing nothing else, your discs are more likely to go out of date with the movement of time than they are to wear out, unless you specialise in pop numbers, whose musical life is limited, anyhow.

Then consider the astronomic improvement which has been made in stereo discs in less than a year, and ask yourself, as I do, where is the bogy of stereo on these grounds?

Someone rang me recently to ask advice about amplifiers, and he was seriously thinking of spending big money on new single channel equipment because "he had a thing about stereo."

If you are one of these, don't.

Whether you like it or not, your ideas are in for a revolutionary change. The pessimists are due for a rude shock as time goes by.

WHAT'S IN A NAME?

The pedants, I notice, by reading some overseas journals, are at it again, trying to work out a name for stereo and mono, which will not only be accurate, but universally acceptable.

Personally, I can't see the practical force of their arguments.

Granted we don't want to fall into the gross error of talking about "monaural," but when it comes to analysing Greek and Latin roots to extract the precise import of "monaphonic" for instance, when everybody knows exactly what is meant, it is carrying things too far.

In using the terms "stereo" and "mono," I think we have gone far enough in our definitions and in our development of words. To add a suffix to either of these is to invite all kinds of awkward and uneuphonious terms about which standardisation would be almost impossible.

The Americans have an excellent habit of abbreviating and even coining words which pithily describe what they mean.

So, why not use "stereo" and "mono" and leave it at that?

Until a better suggestion comes up, that's the way I feel like viewing the subject, except when I feel like having a gentle argument for the fun of it over a cup of tea with Neville Williams!

And he is an expert at arguments.

The World Record Club has completed a deal with the EMI group, which makes available to them a large number of first-class recordings by names which are household words in the recording field, and which should greatly enhance the value of their discs.

The fact that the records have already been issued under the EMI labels, although not necessarily in Australia, doesn't detract from the attractiveness of the deal.

Good records, whether stereo or mono, will always have their place in the scheme of things, and no one imagines that their mono records are any less enjoyable than they have been all these years, and that's plenty.

INTRINSIC VALUE

There are many recordings which are valuable and irreplaceable for their own intrinsic values, and that's one of the virtues of recording as a whole.

We need never lose the touch of Beecham or Menuhin or Claudio Arrau, because they are captured forever on tape and disc.

Witness the value you place on certain special recordings you would never part with, even if their quality isn't top grade, and I don't mean that this applies to the World Record issues.

No doubt stereo will come to the club in due course, but its avowed aim of bringing good records to you at the lowest price will be greatly enhanced by the impressive additions it can now make and is planning to make to its catalogue.

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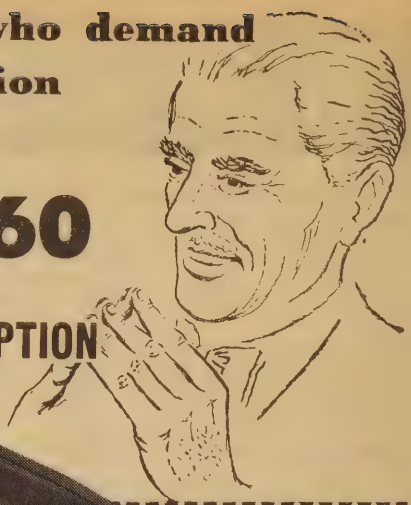

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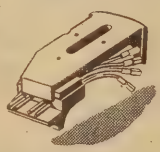
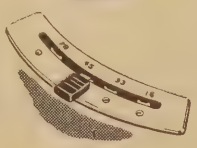


FOUR ADJUSTABLE "CLICK-IN" POSITIONS FOR 16, 33 1/3, 45 AND 78. Continuously variable speed from below 30 r.p.m. to above 80 r.p.m. and from 15-18 r.p.m. ***Ideal for dancing schools.***



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Read these extracts from Technical Reports by P. Wilson, M.A., in a recent issue of "The Gramophone."

". . . extremely quiet in operation." ". . . from 78 r.p.m. the turntable took 3½ minutes to come to rest. An excellent testimony to smoothness of running." ". . . no sign of 'wow' could be detected at all." ". . . ***the overall performance of the GL-60 is so good that it can be recommended to those who want a transcription motor of the highest class.***

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NEW THINGS

One of the experiences I enjoyed in my verseas tour of 1956 was visiting the arious audio fairs, of which several vere held in London while I was there, ot forgetting the demonstrations of G. . Briggs and the E.M.I. stereophonic oncert in London's Festival Hall.

This time I will have more specific ork to do, and I doubt whether I will e able to see and hear as much audio quipment and developments as I did reviously.

However, I will be longer in Europe, nd there are many interesting things oing on.

And as I will be coming home through ngland and America I hope to see at east some of what has been happening ince I was there last.

Like stereo tape cartridges, new peakers, and stereo broadcasting, for nstance.

As opportunity permits I hope to send ome accounts back to Australia while I m away, and at least I should have ome comments to make when I return hich may be of interest to you.

And who knows, there might even be nother stereo concert which might pos-ibly be arranged when that happens.

★ ★ ★

CESAR FRANCK—Symphony in D Minor, Psyche and Eros (No. 4 from the Symphonic Poem Psyche). Played by the Philharmonia Orchestra conducted by Carlo Maria Giulini. Columbia 33CX 1589.

If you are looking for a rich and omantic version of the symphony you on't find it here.

One might almost say that this idea of ranck is out of fashion at the moment. r maybe the extensions and repetitions f the music have warned conductors hat listeners become impatient unless an ffort is made to give them added "in-erest."

Personally, I have always thought this symphony with which one cannot com-romise, any more than with the rest of ranck's music.

He was a composer to whom time eant very little, but ideas and their de-elopment a great deal. He isn't vitally oncerned with your reactions other than o assume they must be respectfully avourable.

Without doubt there are some beauti-ul passages in this symphony, but they ust be allowed to have their way and un their course. To add, subtract, or omment is no more successful than it with his organ chorales.

I agree with criticisms which have een made of this recording, question-ng its style. I think there is a pro-ounced tendency to load it with sig-ificances which are really not there, and hich, in fact, make it even harder than ormal for us to preserve and follow he musical development in our minds.

The score is already extended to great mits, and prodigal with repeats and ash-backs, nor are any of its ideas arth-shattering no matter how much ranck loved them.

Nevertheless there are many good oints about the record, and many buyers mightn't be so impressed with my comments on style.

The recording is a clear one—some-what distant and not very strong in the bass which can make a good deal of all those cellos and basses.

The players carry out the musical plan with consistency and great competence.

Its net rating, including a surface much better than some contemporaries, is among the best, for if it has some short-comings, so have they all.

The excerpt from Psyche and Eros is recommended without any reserva-tions as extremely fine work. As far as I remember no other recording of the symphony contains any additional music let alone of this calibre.

★ ★ ★

VIRTUOSO — Hallelujah Chorus (Handel), Echo Song (Orlando di Lasso), Alleluia (Mozart), Polovtsian Dances (Borodin), Soon I Will Be Done (Traditional), Polly Wolly Doodle (Traditional), Praeludio from Catulli Carmina (Carl Orff). Sung by the Roger Wagner Chorale. Capitol P8431.

A greater contrast in styles could scarcely be imagined than those on op-posite sides of this record.

The first is a mixture of popular items from the Hallelujah Chorus to Polly Wolly Doodle and, if nothing else, they exhibit the wide variety of style mastered by the Chorale.

The second side is taken from a mod-ern work, sensuous and rhythmical, but otherwise rather meaningless unless the listener has more to guide him than the brief note on the jacket.

For this reason it conveyed little to me apart from some urgent atmospheric sounds and a few odd and hi-fi noises from percussion. There are some com-plete recordings but to date I have not heard them.

The singing is well disciplined, the surface quiet and the recording clean and realistic.

Of the shorter numbers I thought the singing very fine, but without much warmth. The Hallelujah Chorus has plenty of vigour but little glory. One of the most attractive numbers is the Echo Song, in which the excellent training and ensemble of the group can scarcely be faulted.

I have a feeling that the dynamics of the main work would be a natural for stereo, so don't be surprised if later on we see a reissue of it in that form.

★ ★ ★

SCHUBERT — Symphony No. 9 in C Major (Great). Played by the Vienna Festival Symphony Orches-tra conducted by Hans Swarowsky. World Record S 12.

This is a record of mixed quality. At its best, and this occurs in the last two movements, it is quite good, although there is nothing in the reading to lift it from the straightforward variety.

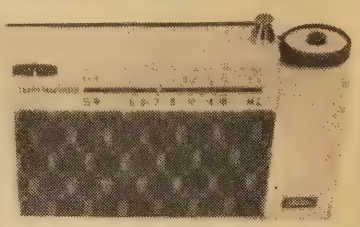
It starts out with such a rush that the first movement never seems to settle down; it jigs at a pace which avoids any suggestion of drag, but prevents the pos-sibility of solid stature.

This brisk approach is more in keep-ing with the later movements and there-fore comes off better.

The sound is quite big, and the bass solid where it should be.

But the recording has apparently used several mikes with the intention of

7 TRANSISTOR PORTABLE RADIO Dual-Wave Model



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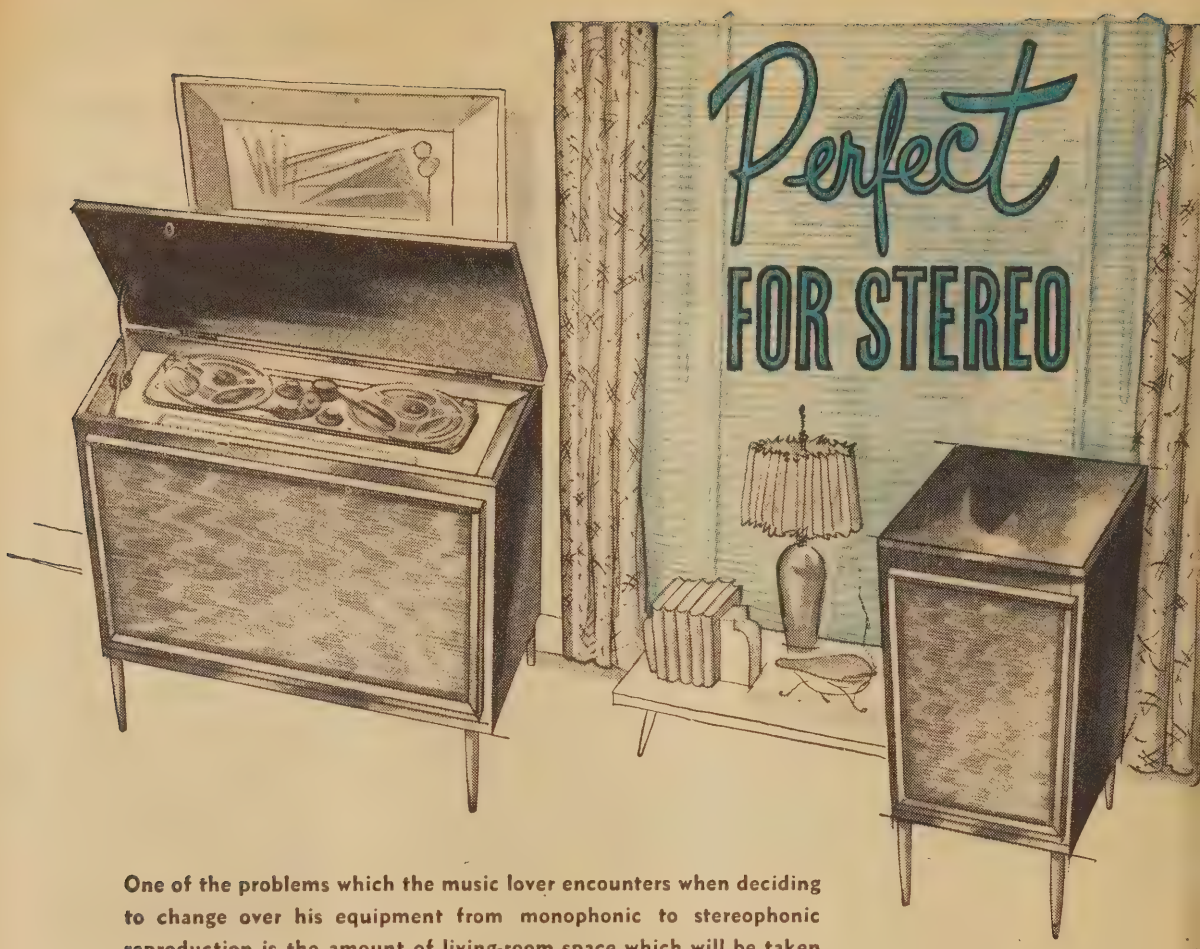
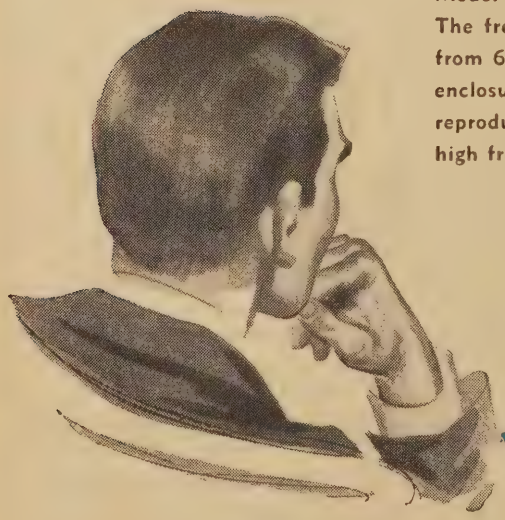


One of the problems which the music lover encounters when deciding to change over his equipment from monophonic to stereophonic reproduction is the amount of living-room space which will be taken up by an adequately baffled loudspeaker for the second channel. Besides seriously encroaching on the floor area, the conventional size enclosures required for 12 inch loudspeakers also introduce placement problems which can prevent good stereo reproduction. It was to overcome these drawbacks that Rola developed the new 8 inch Model 8MX and designed a compact enclosure for use with it.

The frequency range of the 8MX is conservatively stated to extend from 60 cycles per second to 10 K.C., but when used in its special enclosure—its capacity is less than 2 cubic feet—the 8MX adequately reproduces the full tonal range from the organ's deep notes to the high frequencies of the cymbals, triangles and maracas.

Full details of the 8MX and constructional information on the Rola-designed vented enclosure for use with it are available, free and post free, from the Sales Department, Rola Company (Aust.) Pty. Ltd., The Boulevard, Richmond, E.1, Victoria.



aking most orchestral sections of equal udness, and we get some over-promi-ent and fussy passages for the wood-ind, and some reedy quality as well.

Thus while there is enough virtue for to make the grade, and some good laying, it hasn't quite enough to make one of the leaders.

The surface is not normally audible.

★ ★ ★

CORONET ALBUM OF COLE POR-ER—Begin the Beguine, In the Still of ie Night, One of Those Things, Every-me We Say Goodbye, This Thing Call-d Love, True Love, Ridin' High, Love f My Life, Too Darn Hot, So In Love, Don't Fence Me In, Anything Goes. oronet KLP 730.

This is one of the most remarkable ecords of popular music I have heard or a long time.

The orchestra and the conductor-rranger are French, and there is ample vidence that the imagination and sen-tivity claimed on the jacket for both re not overstated.

It's impossible to describe the style, or it is a combination of almost every ne there is, and at times there are two r three going at the same time.

For instance, in True Love one hears Iantovani playing the melody, but the bbligatos which stem from all parts of ie orchestra are completely removed om any sweet strings.

Then again Still of the Night is given it by a female voice without words, id the counterpart is either a cello in s upper register or a viola. It's rather ard to identify.

Everything in the book is used from ne to time, and this contrast in styles one of the disc's great attractions.

Notable too is the very fine record-g that goes with it. I would say it is certainly been made in stereo, and so it would be quite a smasher in its ay.

Whether you want to show off your stem, or just enjoy unusual and vital unds, give this one your ear.

★ ★ ★

HAYDN—Symphony No. 104 in D major (London). MOZART — Symphony No. 34 in C Major. Played by the Philharmonia Orches-tra conducted by Rudolf Kempe. HMV ALP 1471.

Many of the giants in the world of nducting in Europe, and elsewhere r that matter, are men of advanced ars, and before long they will disap-ar from the scene in the normal pas ge of time.

Of those now pressing on to take their aces it seems pretty obvious that udolf Kempe will be one for not only he in great demand in the concert ll, but his list of recordings include any of the first water.

I would without hesitation place this one, and I have rarely heard the ndon symphony played so well.

My only spot of criticism would be at Kempe has underplayed it with a id of gentle restraint which, if less onounced, would have made this cord hard to beat for many a lon y. It still may be.

It is responsive and instantly sensitiv the simple yet subtle devices whicl lighted the mature Haydn, for thi s his last and one of his finest sym onies.

The Philharmonia, completely in har mony with the mood, plays its part with unhurried and relaxed precision and per-fect understanding.

Acoustically the balance is just about ideal. We heard every phrase and every inflexion with all sections in just the right proportions.

The Mozart is a little more closely miked. The sound does not combine with that extra touch of magic to be heard in the Haydn, but it is in the same class.

Strangely to my ears, Kempe hurries the Mozart and loses some of its grace thereby, and stature as well.

There is an aloofness in the Andante which is puzzling, for Kempe is quite able to handle it more sympathetically.

The sharper acoustics could well have accentuated this effect.

But no minor criticisms of mine could affect the quality of this playing.

It's a pity the surface noise is rather higher than it should be, but fortunately not enough to prejudice results.

★ ★ ★

RESPIGHI—The Pines of Rome. Berlioz—Carnaval Romaine. LISZT —Les Preludes. Played by the Phil-harmonia Orchestra conducted by Herbert von Karajan. Columbia 330CX 1548.

Here is a prodigal amount of brilliant and descriptive music, superlatively played in the best traditions of the Phil-harmonia, and that's the same thing as saying it is of top quality.

What a fine orchestra it is!

In the Pines of Rome it handles the tone pictures of Respighi if not with the fullest fire and brilliance certainly with authority and beautifully graded dyn-amics.

The cutting amplitude is very high and very clean, so that there is an im-pressive development of contrasts in light and shade.

The "Pines" is more subdued than the flashing "Fountains" which is its com-panion piece, but they are both unique in their exploitation of tone colour.

Particularly effective are the two slow movements, the last of which includes a scoring probably not repeated else-where in music, and certainly not prior to Respighi.

Scorning to use imitative effects for the nightingale's song at the end of the Pines of the Janiculum, Respighi has called for a gramophone record of the bird itself, and, of course, the recording process manages this much more effec-tively than the concert hall.

It is introduced here with great skill, and the effect I am sure is all the com-poser could have wished.

The tumultuous Carnaval Romaine and the strong colours of Les Preludes make excellent listening.

Both the strings and the brass which are freely called upon will be rich and convincing on any equipment.

If we apply the highest standards to the sound, it could be classed as rather middly, minus much of the top octave which would have been given a true shiver to the brass and a little more character to other instruments.

But this is typical treatment of the Philharmonia's sound—it makes it easy to play and there is no lack of body or fullness in its tone.

And its fine quality is maintained to the last bar.

Extremely good value for the money and for the music. You can't afford to pass it up.

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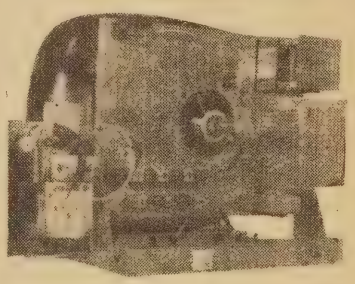

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STEREO — Demonstration disc of classical music by Beethoven, Strauss, Verdi, Dvorak, Schubert, Stravinsky, Wagner, Bach, Wolf-Ferrari and Offenbach. DGG 103002 (Stereo).

Like most demonstration records, this ie has its good points, its excellent ints, and some not so good.

It is different from any of the others that it has no gimmicks at all; no ains, no road drills, no ping-pong atches.

It is all music, and most of it classi-l.

Quite long excerpts are featured from mphonies, operas, chamber music, and final burst from that excellent record-g of Gaite Parisienne which I reviewed cently.

But the best band of them all is the cond, in which the announcer gives little talk about stereo, and some ex-llent demonstrations of it.

In one of these he moves around a ige where the orchestra is presumably out to be placed, and talks from the sitions normally occupied by the rings, woodwinds and so on. The sitioning of the voice as it moves ound in space is most effective.

And so is the extract from "Also rach Zarathustra," which has been osen to drive home the point by a usical example.

Two selections not so effective were e Schubert Trio and some Bach played Foldes.

Both were spoiled by what seemed to fuzziness in recording, although as reo they were both quite O.K.

★ ★ ★

THE SOUND OF WAGNER — Prelude to Act III of Lohengrin, Overture from Tannhauser, Siegfried's Funeral March, Dance of the Apprentices and Procession from the Mastersingers, Ride of the Valkyries and Magic Fire Music from Die Walkure. Played by Erich Leinsdorf and the Concert Arts Symphony Orchestra. Capitol P-8411 (Mono) SP-8411 (Stereo).

The most absorbing part of listening these two discs (the same recording, e in mono and the other in stereo), is to observe the immeasurable periority of the stereo.

As I have been commenting upon ith monotonous regularity and very tle originality, Wagner of all com-sers is one in which the spread and pth of sound are all-important.

Although the mono version is perfect-good in its own right, it is only a adow of the stereo.

This is particularly evident in the ex-rpts from the Ring, where the richly erwoven pattern of motifs and chestration must be heard separately d together at the same time.

No matter how skilfully the mono kes are arranged, its just isn't possible achieve the same dimensions.

It isn't just a matter of the separation reo allows, in fact it is just the oppos-, for there is mercifully no sign that engineers have indulged in any sonic inting.

OLID SOUND

It is the blend of sound that matters, solidity which extends right across room, the architectural realism that ngs the music to life, and I'm sorry I offend by quoting an advertising irb which for once is the plain truth. Not since the memorable performance at Covent Garden in 1956 to which I have frequently referred, one considered by critics as being the best for years, have I experienced the same response to the moving passages of Wotan's farewell, even shorn as they are of the full continuity which is the sad but inevitable fate of all excerpts.

It increases my impatience to hear some of the complete operas which have been released overseas, and hailed as landmarks in the recording art. If they are to be as good as reported, this disc will give you some idea of what you may expect.

For, despite their inevitable sketchiness, these performances are good. They lack something in subtlety, but not in directness and simplicity of statement, they sound at times confined as though in a theatre, but they are clearly articulated. Leinsdorf hurries some of them, but that is hard to avoid in a concert version when the needs of the live performance are not there to temper his pace. He has been forced to do some arranging but it is done as well as we might expect.

The mono disc is cut a little more deeply, and has the more prominent bass. To have lifted it so much for stereo would have been out of place — yet another example of how the removal of the single channel strait-jacket has liberated realism.

These recordings are almost veterans in stereo now, but their surfaces are quite acceptable although you may find that rumble emerges if you try to lift the bass at more than moderate volume.

I can recommend both in their class, and particularly the stereo as an example of Wagnerian promise.

★ ★ ★

IMMORTAL SERENADES — Music by Toselli, Bizet, Romberg, Mozart, Pierne, Offenbach, Tchaikowsky, Drigo, Donizetti, Schubert, Braga, Young, Berlioz and Mascagni. Played by Frank Chacksfield and Orchestra. Decca LKA 4283 (Mono) SKLA 4283 (Stereo).

Pleasant and easy to listen to, this record contains a wide mixture of serenades, all popular in both the classical field and otherwise. Most of them are arranged by Victor Young, one of the immortals of light music.

Some may find the proponderance of strings a little tiring, but then they may not play the entire group of 14 numbers without a stop and twice over; once in mono and once in stereo.

Separated sections are used firmly but not prominently to give a variety most welcome in stereo but naturally absent in mono.

Their effectiveness is quite noticeable in the lessened sound intensity of the strings in stereo which do tend to focus sharply with the single channel.

As with most Deccas they have a fully developed sharpness which highlights this effect and which can be tamed with a little top cut.

A couple of guitar solos are very clean, being picked out by the mikes in forward outline, but in this kind of music odd tricks are not out of place, for the prime intention is not to reproduce any special grouping as a musical entity but rather for the interesting effects they produce.

The general sound of both versions is almost identical.

The surfaces of both are very quiet, particularly the mono, in which surface noise is non-existent.

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SYDNEY

SHORT-WAVE NOTES BY ART CUSHEN

B.B.C. VERIFIES RECEPTION REPORTS

Alteration of the policy of the non-verification of reports on the reception of broadcasts now permits the B.B.C. to verify the reception of their transmissions by listeners.

AN official of the B.B.C. in London has advised us that a change in policy has been made, and all reports on the broadcasts are now verified. A card is now sent, which states the findings of the report on reception. The B.B.C., in requesting information about reception of the broadcasts, require information on the date and time of reception of the transmission, the frequency monitored, brief program details to help identify the transmission and some estimate of the quality of reception.

The verification card shows Big Ben tower against a black background. The reverse side contains the verification details and the card is divided into four sections so that the one applicable is marked. The address is given as B.B.C., Bush House, Strand, London, WC2.

The verification details state, "Thank you for your request for verification, the appropriate finding is indicated thus (x).

(a) Your report was in accordance with our published schedule, and was on ..... kilocycles ..... date. (b) You probably heard one of our transmissions but the information does not entirely confirm this. (c) This may have been a rebroadcast of our program by another organisation. (d) Your reception does not seem to agree with any of our transmissions at the time you give."

LEIPZIG ON 9730 KC

BROADCASTS from the Leipzig station which identifies as the "Voice of the German Democratic Republic" is being received at good strength on 9730 Kc. The station has an English session at 4.00 a.m., 6.00 a.m. and 8.00 a.m. and the program, as well as being on Leipzig, is also on the Berlin relays on 7155 and 6115 Kc.

The program commences with a session of news in English which is followed by a commentary and then music for the 30-minute period. The Leipzig signal is the best of the three and the transmission appears to be received stronger than former programs, which seems to point to increased power from the old 7500 watt station, which formerly carried the signals.

DX SESSIONS

THE popular DX session from Radio Japan has been switched to the third week of each month, and is now available to listeners in Australia and New Zealand from 7.55 p.m. on Saturday. The program is carried on 11940 and 15235 Kc. The broadcast is repeated for other parts of the world including Hawaii at 3.10 p.m. on Friday, Europe at 6.10 p.m. on Saturday. North America at 10.55 a.m., Sunday.

The DX Corner from Berne, in Switzerland, has also undergone some alteration and is heard in the Pacific transmission for this area at 5.50 p.m. on Fridays. The program now has alternate news for the commercial short-wave listener, and for the radio amateur on a weekly basis.

The session can also be heard in the service to North America, when it is broadcast at 2.50 p.m. on Saturday. On both transmissions, the 11865 Kc channel gives best reception.

VERIFICATION FROM ANDORRA

THE Andorra station, which has been in the news over the past few months, has been verified at last and the conflicting news on its schedule and frequency has been clarified by the station. Verification is in the form of a photo of the transmitters and the station, which uses the slogan Andorradio, has the address of P.O. Box 7, Andorra la Vella. Verification is from G. L. Hemeret, president of the station. Power on 6305 Kc is 1000 watts, and the medium-wave outlet of 8188 Kc with 100 Kw. Schedule is shown as 10.00 p.m. to midnight and 4.00 to 9.00 a.m.

Another verification of interest is from the Radio Rural transmitter, which was reported in April. This station, using 15105 Kc, has the asigned call of ZYZ32 and, on 6065 Kc, has the callsign ZYZ31. The station confirms reception with a postcard and pennant. The station is operated by the Department of Agriculture in Rio de Janeiro, Brazil.

KABUL VERIFIES

A VERIFICATION by registered mail from Radio Kabul, Afghanistan, verified our reception of YAK on 4710 Kc, which made our 171st country to be verified. The card, which gave details on the transmitter as using 10 Kw, stated that it is anticipated further short-wave transmitters of 10 Kw are planned. The station has recently moved to 4770 Kc, and a change has been made in the times of the foreign news services. Kabul has Persian from 2.00 to 3.00 a.m., Urdu from 3.00 to 3.30 a.m., English 3.30 to 4.00 a.m., and Arabic from 4.00 to 4.30 a.m.

BROADCASTS FROM ATHENS

THE broadcasts from Athens have been the subject of two recent inquiries—from Mr H. Viney, from Peterborough, S.A., and W. Spana, Rose Bay, N.S.W. Both ask for details on the reception of this station.

The Athens transmissions are one of the hardest to hear from Europe, due to the fact that the low powers of only 7500 and 5000 watts are employed. The best reception is during the summer months and, on Sundays, the listener should be able to hear the transmissions from 3.45 p.m. when opening with a church relay. The station at this hour is best on two frequencies, 15... and 9605 Kc. A further frequency on 11... Kc is also used at times, but this channel would be hard to hear due to the close proximity of the broadcasts of Melbourne when using 11... Kc.

NEWS FROM ROME

A SESSION of news in English is being received on the Italian third program broadcast on the Caltanissetta transmitter using 9... Kc. The program has been heard shortly after 3.03 p.m., when it is released for four minutes with the preceeding and following programs being in Italian. Signals are very good on this hour service relay and this appears to be a new departure for the Italian Radio to include a broadcast of news in English on a purely local program.

UNIDENTIFIED SIGNALS

A PERUVIAN signal on 5010 Kc has so far baffled the listeners as to its exact location. This station was first heard by a New Zealand listener closing at 5.00 p.m., when the station announced they had concluded their first regular broadcast. The station asked for reports and identified with the callsigns OAX7X and OAX7...

SAO PAULO is understood to be the location of a new Brazilian heard on 17725 Kc to close at noon. The station has a program of continuous Portuguese music and closes at this hour rather abruptly.

FLASHES FROM EVERYWHERE

SWITZERLAND has put into service a new 13 Mc frequency for the service to India and Pakistan, this is 21605 Kc and it replaces 11865 Kc. The callsign HE19 is used on this transmission which is on the air from 12.45 to 2.30 a.m.

MOMBASA of the East African Broadcasting Service in Kenya has made an alteration to its frequency and it is being now received on 4965 Kc. The station has programs in Arabic from 4.00 a.m. to 6.00 a.m., at which time they leave the air.

TANGIER station Ibra Radio, which we have reported on one of the stations in this area to cease transmissions at the end of the year, has moved from its out of band frequencies and been reported as using 9630 Kc. A Japanese listener states signals are at fair level from 5.00 to 7.00 a.m. Ibra Radio was formerly using 9275 Kc.

Short-wave news from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Australian Eastern Time.

KOREAN BROADCASTING SYSTEM has again changed its low powered outlet which for some time was on 7935 Kc and then on 6935 Kc. The latest reception has been on 6035 Kc with the English news broadcast from 7.30 to 8.00 p.m. Reception was in Japan, and in this area it would not be possible, due to the use of this same frequency by Radio Noumea.

NORTH VIETNAM signals are reported to be well received in Warrnambool, Vic., by Bill Harthorne, who hears them in English from 11.30 p.m. to midnight. The signals are further received on the same frequencies with English from 1.15 to 1.45 a.m., using 11840 and 9840 Kc. The broadcasts originate from the North Vietnam capital of Hanoi.

SUCRE in Bolivia is understood to be the location of a weak signal, which is being heard on 9200 Kc from 10 a.m. to sign-off at 5 minutes past noon. This Bolivian is one of several we have been hearing, but signal strength is very weak, the best one at the moment is the CP38 signal on 9440 Kc which has the religious programs from La Paz and uses the slogan "La Croix de Sud."

BELGIAN CONGO is operating a new regional station at Luluaville, which is using 6127 Kc for the broadcasts to 4.30 a.m., closing with the Belgian anthem. The station carries local news at 3.30 a.m. in French and interference is rather severe from the Limassol Cyprus transmissions on 6120 Kc according to a reporter in the Middle East, who has heard this new transmitter.

MAURITIUS is to use a new, higher power, as we reported recently, and the frequencies and schedule of this new 10 Kw station has been announced. The station is to use 6101 Kc with incident array aerial, and this type of aerial will largely restrict the coverage to the Maurit... area. The station plans to operate from 1... to 2.15 p.m. on 6101 Kc, 5.45 to 7.30 p.m. 6101 Kc, and from 12.30 to 3.30 a.m. on 6... or 3325 Kc, the latter frequency to be us... depending on the tests which are now be... carried out.

SENEGAL station Radio Dakar, has again b... heard in its transmission with its broadcast fr... 2.30 to 6.00 p.m. and, at this hour, the tra... missions are on 9562 Kc with strong signals, ... also fair level on 7210 Kc and weak on 4... Kc. The broadcast has also been reported ... early as 3.00 p.m. but, at this time, signals ... only be heard after the closing of Radio Nacio... Lima, broadcasting on the same frequency. T... latter station closes between 3.00 p.m. and 3... p.m.

BRAZZAVILLE station Radio AEF has appea... on 9545 Kc in the afternoons, according to ... listener in California. The station has b... observed on this frequency opening at 3.30 p... and has news in French at 4.00 p.m. In t... area it is not possible to follow the transmiss... after 3.55 p.m., at which time Radio New Z... land opens broadcasting on 9540 Kc.

HILVERSUM has commenced extra transm... sions in Dutch for listeners in both New Zeal... and Australia. The New Zealand service is ... the air from 4.00 to 4.20 p.m., using 15220 ... 11730 Kc. The service to Australia is on ... air from 5.30 to 5.50 p.m. using the same ... quencies. Programs in Dutch for listeners ... Australia and New Guinea continue to be bro... cast on the regular service 7.45 to 9.45 p.m. ... 25610, 21480 and 17775 Kc.

CUBAN station Radio Cuircuito, CMQ and ... short-wave COCQ has been heard on 9668 ... The broadcast is from 8.30 p.m. to 11.00 p... and again from 6.00 a.m. to 2.00 p.m.

RADIO INTER EQUATORIAL is the ... slogan of the old Radio AEF station now bro... casting from Congo Republic, transmissions b... radiated from Brazzaville. The 90 Kw transmi... on 9545 Kc is in use to 4.55 p.m., when ... quency change to 9620 Kc is made. Broadc... are then from 5.00 to 5.30 and when the sta... relays Radio Brazzaville, which also uses 11... and 11970 Kc at that hour. The transmissi... of Radio Brazzaville have been noted on ... additional frequency of 21500 Kc in the ser... to the Far East. This release is on the ... 11.30 p.m. to 1.15 a.m., which is also relea... on 17720 Kc.

CAIRO has replaced its 15420 Kc freque... by 17915 Kc channel, for its transmission to ... Arabs in Africa. The station is on the air ... this new frequency from 3.00 to 5.00 and ... to 8.30 a.m.

CENTRAL AFRICAN REPUBLIC now bo... a 3.5 Kw transmitter, which is used by R... Bangui,, and it is broadcasting from 2.45 to ... a.m. on 5982 Kc. On Sundays the transmis... is from 6.00 to 10.00 p.m,, 9513 Kc, and, ... both frequencies, the power is 3500 watts.

AMATEUR BANDS WITH BILL MOORE

At the time of publication of this journal delegates to the Geneva ITU Conference will have already assembled in committee. Radio amateurs from many nations will be in attendance in an endeavour to ensure the retention of adequate frequency allocations for future operation. Their task will not be an easy one.

OHN MOYLE, VK2JU, official WIA obser-ver-adviser on amateur radio matters to the neva International Telecommunications Union's dinary Administrative Radio Conference, left ney on August 7 to attend. John has a job ahead and amateurs wish him the best his presentation of a case for the Austra-n amateur service.

An interesting valuable suggestion that arose ing a meeting of Australian delegates to ITU ore John's departure was an annotation to original proposal for an exclusive 7.0 to 7.1 /s amateur allocation. It was to the effect t consideration would be given at Geneva an extension of the band to 7.3 Mc/s a daylight hours shared basis with shortwave adcast services. The proposal was sponsored the WIA observer and supported by many the delegates assembled.

f we are to lose frequencies a grant such that would certainly offset the 50 Kc/s cut posed for 7 Mc/s.

he immediate past president of the Radio iety of Great Britain, L. E. Newham, G6NZ, been appointed as an adviser to the U.K. gation to Geneva. This is an important cession granted to the amateur service, and, here in Australia, it is the first time an ama- representative has attended as an official nber of an ITU delegation.

revious delegates from the RSGB, who at-ded Madrid, Cairo, and Atlantic City ITU ferences were as observers nominated by the rnational Amateur Radio Union.

ieneral manager A. L. Budlong, W1BUD, and stant general manager John Huntoon, W1LVQ represent the ARRL as members of the delegation. The Canadian director, Alex d, VE2BE, will attend as a member of the cial Canadian delegation.

ther officials from the league attending will the general counsel, Paul M. Segal; ARRL ident Goodwin L. Dosland, WOTSN, and nical director George Grammer, WIDF. mateurs can rest assured they will be well esented.

he proposed cuts to Australian amateur fre-ncies and their extent is well known. At time of the delegates' departure the full of the proposals by nations concerning ama-radio were not known.

ne suggestion sponsored by a number of ppean nations provided for a world-wide cut he 7 Mc/s band to 7.0 to 7.15 Kc/s. They support a cut of the 28 Mc/s band from to 29.7 to 28.0 to 29.00 Mc/s. India even posed a cut of the 3.5 Mc/s band from 300 wide to a mere 15 Kc/s!

atures from which we can have some hope hat U.S. proposals provide for a continu-of all amateur bands now occupied. The proposals will be largely to maintain the s quo.

due course news of all proposals will be ilable and some indication of the likely trend ilable.

DX CONTEST

HE VK-ZL DX contest for 1959 will be con-ducted as usual in October. The National teur Societies of Australia and New Zealand, W.I.A. and N.Z.A.R.T. run the contest in and this year the former organisation directs contest.

e following is a summary of the major rules: duration of the contest is 24 hours over of two weekends. The first session is the e section running from 1000 G.M.T., Satur-October 3, to 1000 G.M.T., Sunday, October

e CW section runs from 1000 G.M.T., Satur-October 10, to 1000 G.M.T., Sunday, October

e contest is divided into three main sections mitting Phone, Transmitting CW, Receiving e and CW.

y amateur band may be used but cross-band ing is not permitted.

e usual serial numbers must be exchanged e points are claimed, five figures for phone ix figures for CW.

ries should be post-marked not later than ber 31 and addressed to the Federal Contest mittee, W.I.A., Box 2611W, G.P.O., Mel-e, C1, Victoria.

ring for VK and ZL stations is as follows:— points will be scored for each contact on cific band with an overseas station, and in on for each new country worked on that

I.G.Y. PROJECT

THE report of the A.R.R.L.'s I.G.Y. Project Supervisor, Mason Southworth, WIVLH, on the League's Propagation Research Project provided many facts of the value of the venture. It clearly shows that amateur propagation studies are of worth and the day of amateur contributions to the communication art is by no means over.

The work is still in progress and about 100 stations have been selected to continue to participate and are arranged to obtain an even geographical distribution.

These amateurs are submitting monthly log details covering 50 Mcs trans-equatorial scatter propagation, the field least understood, besides supplying general information on 50 Mcs openings.

The data is being collected by the A.R.R.L. and processed in conjunction with a study conducted by Stanford University. The program is aimed at unravelling some of the mysteries of TE propagation. Incidentally, before the original A.R.R.L. P.R.P., the only TE paths observed were between North and South America.

Other paths that opened during the project were from Japan to Australia and Papua, Hawaii to Australia and Papua, Hawaii to Cook Islands, Madeira to Urugay and Rhodesia, France to Rhodesia and Cyprus to Rhodesia.

During this original project there were 592 active observers in 50 countries reporting on 50, 144 and 220 Mcs band accomplishments. These reports resulted in an accumulation of 300,000 I.B.M. punched cards. These were processed at Air Force H.Q.s at the rate of one card every couple of seconds.

The machine provided the distances between stations making sporadic E contacts and the paths were automatically plotted on a series of maps and it was possible to visualise the motion of the ionised patches which provided the sporadic E contacts.

Participants in the A.R.R.L. project received certificates, a special four-colour feature was awarded to 33 amateurs and one S.W.L. These certificates were issued under the seal of the Executive Director of the U.S. National Committee for the I.G.Y., U.S. Air Force Director of Geophysics Researcher and the President of the A.R.R.L.

Amateurs working on the current TE program have full-time beacons running on 50 Mcs with signals beamed on South America and a TEW (trans-equatorial warning) system. The latter is a network of amateur stations stretched along the east coast of the U.S. When any South American signals appear after 1600 hours local time he telephones the station north and south of him so they can check the 50 Mcs band. If TE signals are heard the news is passed up and down the coast.

Work at this time of the sunspot cycle should prove valuable as TE peak conditions were observed to lag the maximum of the cycle by a year or more.

First contact, 50 points; second contact, 40 points; third contact, 30 points; fourth contact, 20 points; fifth contact, 10 points.

For the purpose of this rule the official countries list will apply with the exception that each VE, W and ZS call area will count as a separate country.

Logs should show a separate score for each band and the usual general information and declaration.

The W.I.A. will award certificates to the top scorer on each band and to the top scorer in each VK and ZL district. Additional certificates may be awarded depending on the number of logs received.

The unusual DX station often appears in the contest and it is well worth entering.

ACTIVITIES IN THE U.S.

THE A.R.R.L.'s original proposal to extend the U.S. amateurs' voice allocation on 14 Mcs up to the high edge of the band has now been filed by the F.C.C. for comment by interested parties. The proposed new telephony segment would read 14,200 to 14,350 Kcs, an additional 50 Kcs.

The reasons propounded by the A.R.R.L. for the extension include the increase in licensed stations and the greater percentage interested in telephony. It was hoped that the newer 21 Mcs band would relieve some of the crowding on the 14 Mcs segment but this has not proved to be the case.

They pointed out that although the amateur population in the U.S. had increased threefold to over 180,000 licencees the original 100 Kcs phone allocation has never been increased.

The A.R.R.L. is well aware that some amateurs outside the U.S. oppose the extension of the

John Moyle, VK2JU, photographed as he boarded the Qantas Super Constellation at Kingsford Smith Airport, Sydney. Sponsored by the Wireless Institute of Australia, John will be one of several observers watching amateur interests at the Geneva Convention.

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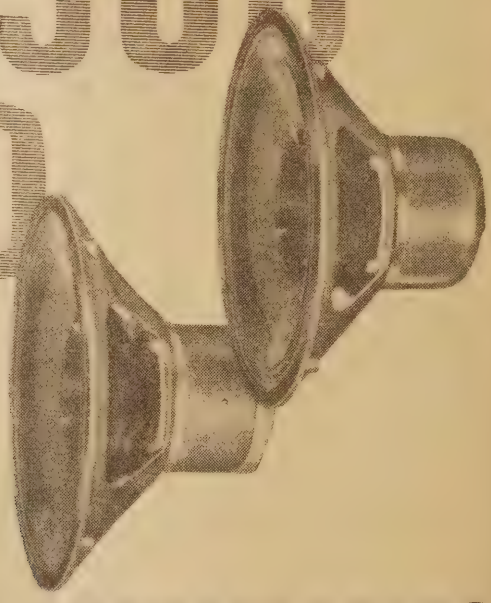

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hone allocation at 14 Mcs. These amateurs feel at such expansion would reduce the band width ailable to them and that is a reasonably true sumption. Few foreign amateurs would normly operate in the U.S. telephony portion of the nd since they cannot compete with the WKW. The A.R.R.L. admits this opposition and the ews expressed as a valid argument but consider at the other advantages far outweigh this one advantage.

If this extra segment is granted to the U.S hone amateurs operating procedures will certainly change. Telephony stations in other parts the world will be hard pressed to fit in between 14.100 and 14.200 Kcs without extending to the low 100 Kcs used practically exclusively r CW. The S.S.B. gang will have to find a w spot as so many used the high edge of the nd.

Quite a number of amateurs in the U.S. have tained licences for the citizen band at 11 etres and use some of the 22 channels available at that frequency.

An amateur licence does not authorise installtion, servicing or maintenance of citizens' band uipment, for which a second-class commercial cket is required. It seems strange that amateurs no use a KW at 10 metres have to leave the ystal controlled 5 W.A.H transmitters alone.

The rules for citizen band operation specify ort distance radio communication work and at contacts should be as brief as possible.

It is pointed out that the band is a mammoth rty line and licensees must respect the rights others who use the channels. If operators ntinue in their endeavours to work all States d carry out rag-chews the F.C.C. will have to ghten up the regulations. Citizen band stations n only contact one another. The facilities of e band are available to all members of the blic on obtaining the required licence and inalling approved type equipment under supersion.

Any citizen over 18 years of age on filling in C.C. Form 505 can obtain the licence.

A number of American manufacturers are supying special equipment for the band. Receiver-insmitter units, rabbits ears, ground planes and en three element beams are types of gear prorable.

Another first in amateur communication was the eration in the 28Mcs band of W8NPC from e Atom Fair in Ohio. It was nuclear powered mmunication and the power was derived from 4lb battery of radio-active isotopes. The batry delivered 60 watts of heat. Three watts at ree volts were obtained from a thermocouple d converted to 24 volts for transistors. It was mated that half a wat was delivered to a hree-men beam for a 1,000-mile contact.

NEW WORLD RECORDS

WO of the VHF world records were shattered in the middle of the year. The first one oken was by Swedish and British amateurs on 420 Mcs band.

G2XV and SM6ANR had a 15-minute contact er a distance of 600 miles. Other U.K. stations work with the SM were G3HBW, G6NB and KEQ. G2XV's aerial on 420 Mcs is a 40 ment array (20 driven and 20 reflectors) at a ght of 40ft.

The 220 Mc record was greatly extended when 16UK, Hawaii, and W6NLZ, California, conted.

It was these two stations that a couple of rs ago bridged this portion of the Pacific to ablish a new 144 Mcs record (it still stands) 2,540 miles, and now this figure is current for 220 Mc record. They successfully used both B and CW during the QSO.

t was announced by propagation experts early the year that 1959 would be the year for 220 s DX working. U.S. amateurs have been contrating on 222 Mcs, as a national DX freency, due mainly to serious TV receiver oscilor QRM around 220 Mcs in some areas.

ohn, W6NLZ, was running a KW on both / and SSB on 222 Mcs during his KH6 con. Regular schedules paid off as they did for establishment of the 144 Mcs record.

VHF NEWS

HF news for the month shows that the JAs were heard as far south as Melbourne and Adelaide and judging from the times by TE pagation. VK3ZFM heard them on July 20 at the end of the month 50 Mcs was open JA from VK3, VK4 and VK5. Mac Hilliard plied the above news and in a letter from ZJV well-known African VHF station obtained le interesting information. During June the contacted W stations consistently. From uary through to April he had openings every ht on 50 or 72 Mcs to ZC4, Cyprus.

le has heard TE signals as high as 90 Mcs times. ZE2JV is on the look-out for VK tions and operates on 50.040 Kcs. He requests s on his frequency and uses 28 Mcs for king purposes. Mac will shortly receive from ZE a tape recording of the VHF signals he ives, it should be worth hearing.

Ir Alan Johnson, of the P.M.G.'s Department, ured at the August meeting of the N.S.W. F and TV section. A much discussed subject covered, that of transistor power supplies. lecture was of great value to the VHF ernity as so many of them operate mobile lecturer was inundated with questions at the clusion of the discourse.

ob Ridgley, VK2ZAR, will lecture at the Sepber meeting scheduled for September 4 and h subject, UHF techniques.

REORGANISATION OF W.I.A. POSTS

THE N.S.W. W.I.A. council at a special meeting reorganised the administrative side of the division. Some new positions were created and the activities generally streamlined.

Norm Beard, VK2ALJ, retains many of the secretarial and treasurer's duties but Tim Mills, VK2ZTM, relieves him of a number of specific jobs.

Harry Harris is in charge of the monthly bulletin and Nev Sneddon, VK2WS, will arrange its dispatch. Bill Lewis, VK2YB, still prepares the envelopes.

The VK2WI Broadcast Committee comprises Dave Duff, VK2EO; Ted Whiting, VK2ACD; Keith Woodward, VK2ZAU; and Bob Luther, VK2ZEL.

Education and the newly organised slow Morse classes on 3.5 Mcs will be in the hands of Max Sobels, VK2OT.

A new departure is the appointment of a reception committee to assist visitors to find their way around Sydney and to meet other amateurs. These duties have been taken over by Ted Whiting, VK2ACD, and George Rutter, VK2CB. Both have other duties. Ted is also responsible for publicity and "Amateur Radio" and George is officer-in-charge, VK2WI, Dural.

Bob Luther, VK2ZEL, is also librarian and Keith Woodward, VK2ZAU, in charge of zones.

The QSL Bureau is still in the capable hands of Frank Hine, VK2QL, and Noel Taylor, VK2ASQ. W.I.C.E.N. officials are Bob Winch, VK2OA, and Max Pfeffer, VK2MP; the former also is Federal traffic officer. Federal councillor is Bob Godsall, VK2ARG.

The Disposals Committee which has been doing an excellent job for many years is still Allan Williams, VK2FH; Alec Dan, VK2ABU; and Harry Solomons, VK2AJZ.

The Social and Convention Committee, a new permanent body, will comprise: Max Pfeffer, VK2MP; Ted Whiting, VK2ACD; and Bob Luther, VK2ZEL. A number of the above officers have been performing the tasks mentioned since the start of the year.

The N.S.W. division of the W.I.A. arranged a demonstration of amateur radio during the Willoughby Youth Festival Week. Equipment was installed on the arts and crafts stall on August 10 and 11 at the Chatswood Town Hall. A two-metre link was arranged at the hall to trigger VK2WI, Dural, some 15 miles away and the public were shown a facet of amateur radio W.I.C.E.N. operation. On the Monday evening aldermen of the Blue Mountains and Willoughby exchanged greetings.

The Mayor of the City of Blue Mountains and the Mayor of Willoughby spoke.

Later the Blue Mountains Civil Defence Controller, Colonel Strachan, and the W.I.A. State W.I.C.E.N. Co-ordinator, Bob Winch, VK2OA, discussed aspects of W.I.C.E.N.

VK2WI then proceeded to work net stations throughout the State and demonstrate to the public in the hall the workings of amateur radio.

The Hunter branch annual dinner and Blackalls Field Day are scheduled for the Six-hour Day weekend. The dinner on October 3 and the field day on October 4. Anyone interested should contact Gordon Sutherland, 15 Marine View, Newcastle, for accommodation and bookings.

The second amateur event to be held in N.S.W. over the Six-hour Day weekend in October is the W.I.A.'s South-West Zone's Convention. The location is changed annually and this year will be held at Narrandera.

The convention will be conducted during Narrandera Moonar Festival and some of the functions associated with the carnival should prove attractive to the ladies. Full details will be publicised later. Ted Whiting, VK2ACD, will represent the N.S.W. division at the convention.

Bookings are in the hands of Frank Pearson, VK2ACQ, at Frederica Street, Narrandera, and early applications for accommodation, etc., would be appreciated.

SILENT CALLS

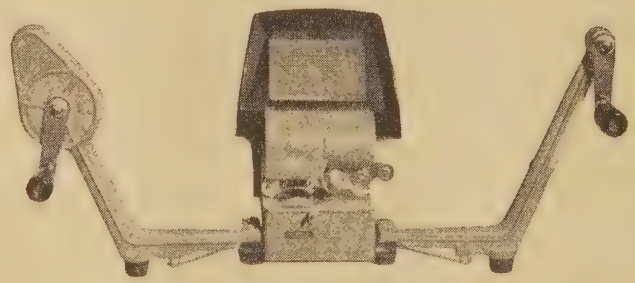
DURING July two well-known VK2 personalities in amateur radio passed on, they were Alex Skenesmith, VK2SS, of Blackheath, and Dave Evans, VK2AYE, of Sydney. They were both keen 40-metre operators and known to amateurs throughout Australia. Skene was an old-timer and could be heard often expounding the virtues of the Blue Mountains. He was a guest of the Japanese during World War II and for some years had not enjoyed the best of health.

Amateurs extend their deepest sympathy to his wife.

Dave, whose job took him to most Australian capitals, had many interstate friends. He was active through the years in many W.I.A. offices.

VK2AYE will be remembered for his firm convictions on many subjects. Since a major operation last year Dave was not well. His funeral, held on July 29, was attended by many amateurs and W.I.A. officials. To his sister, who arrived from England last year, sympathy is extended.

The 40-metre band has lost two personalities and two ardent operators



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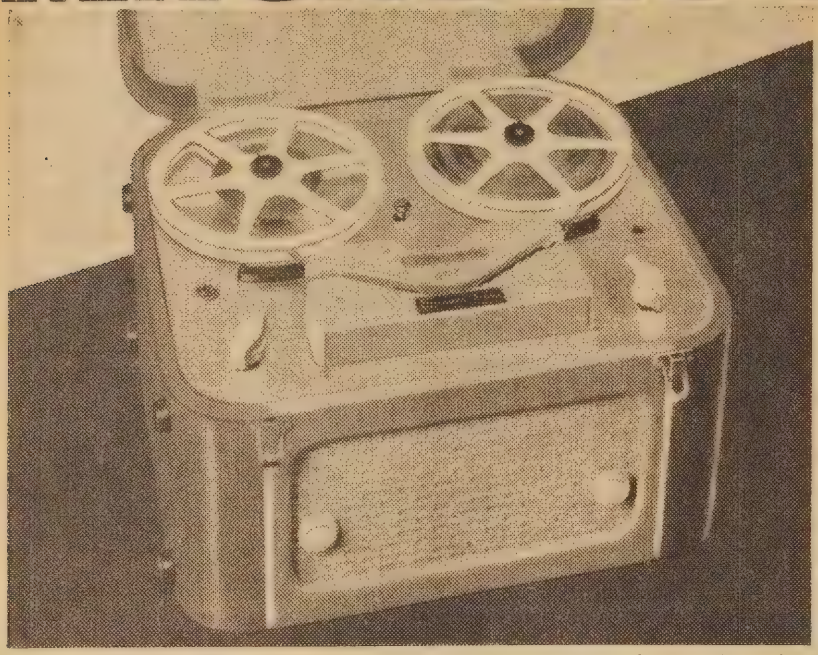

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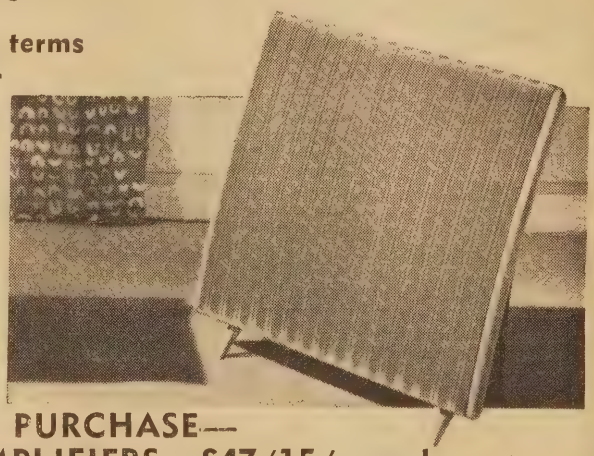

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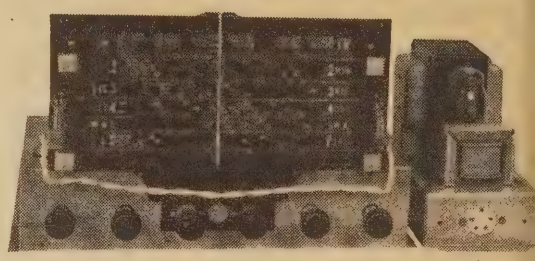

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5in Wide Band
10 Valves
P.P. X & Y Amplifier
5 Step. Input Attenuator with voltage reference.
Time Base. 10 C/s to 100K.C.
Band Width 1 Meg.
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To Rola Dimensions for 8 MX Speaker
White Finish
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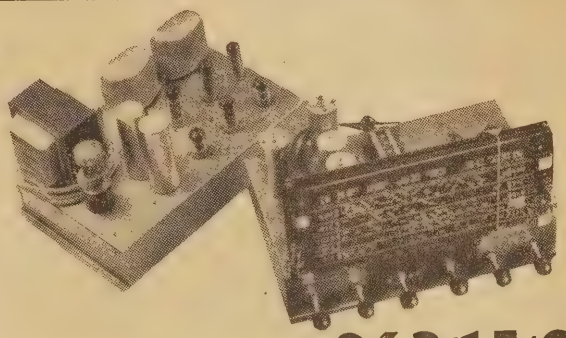
EVENINGS and WEEKENDS: "KALUA", Hilma St., Collaroy Plateau — XW5956
DULWICH HILL, UNDERCLIFFE, EARLWOOD, BUS AT DOOR, STOP No. 42

15 VALVE STEREOGRAM 20 WATT



2 Mullard 5-10 Amplifiers provide frequency response of 10 to 30,000 cycles. Speakers, 2 Jensen 12in Woofers and 2 Jensen 6in Tweeters limit this response to 40 to 14,000 cycles. Valve line-up 2.6BA6, 1.6ANX, 1.6AV6, 1.6BR5. 2.EF86, 2.12AX7, 1.12AT7, 4.EL84, 1.5AS4.

All controls mounted on tuner chassis and coupled to amplifier chassis by low impedance co-axial lines.

5 position function switch selects inputs as follows: Stereo, Monaural, Radio, TV or Tape Recorder, Crystal Microphone, also correct loading and compensation for each function and microphone pre-amplifier.

£63/15/0

2X ROLA. 8MX SPEAKERS **STEREO RANGE**

5 Valve D.W. Mullard 2x2 Audio £33/10/-
6 Valve D.W. Mullard 2x2 Audio £34/10/-
8 Valve D.W. Mullard 3x3 Audio £36/15/-
10 Valve D.W. Mullard Audio £46/15/-
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8 Valve D.W. R.F. Stage Mullard 2x2 Audio £36/15/-

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"KALUA,"
HILMA ST., COLLAROY.

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For 12V. operation only using 4 Hybrid Valves, 2 Transistors.

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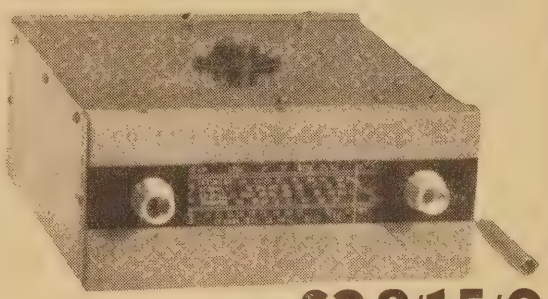
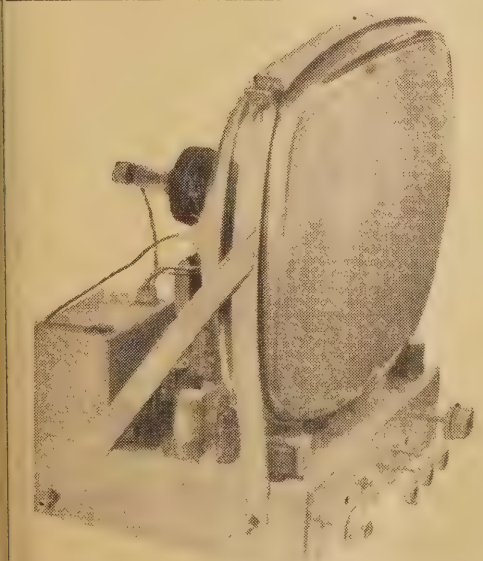


£28/15/0



R. TV & H. '59 TV

21 inch 110 DEGREE

The complete kit of parts to R.TV&H specifications and layout including:
VALVES, TESTED STEANES TURRET TUNER & I.F. STRIP, TUBE MOUNTS AND MASK.

£105/0/0

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FOR FRINGE AREAS

17 valves. 4 stage Strip. Prealigned and tested.

Philips NEW Hi-Gain Tuner £107

Any individual parts, I.F. Strip etc., can be supplied to order. Prices on application.

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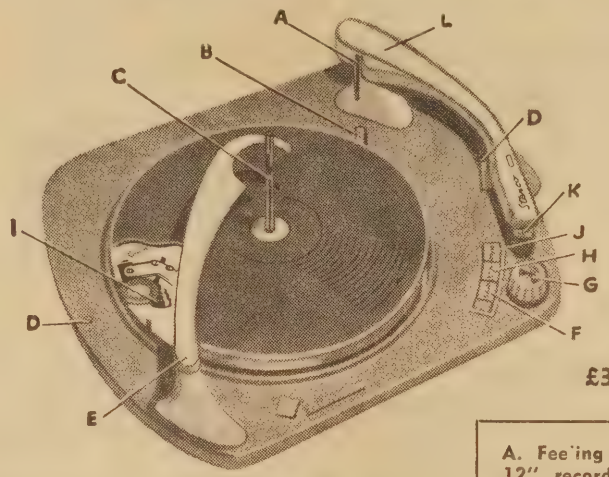
Wired and tested Video Strip, with Valves .. £11/15/-

TELEFUNKEN
Stereo
RECORD CHANGER



Retail
£30/10/6

A. Feeling lever for 12" records.
B. Contact button for 10" records.
C. Changer spindle.
D. Perforation for fastening screw.
E. Record ballast arm.
F. START *(switching on, immediate change).*
G. Speed setting knob.
H. STOP *(switching off)*
J. REPET *(repetition)*
K. Setting of sapphire styli.
L. Pick-up arm.
I. Step pulley.

. . a marvel of precision — masterpiece of design

In Europe, experts were so impressed by its features that twice they awarded it a prize at the Exhibition of perfectly styled industrial products. This honour has been achieved only by the **TELEFUNKEN Record Changer.**

The TELEFUNKEN Stereo Automatic Record Changer, Model TW562, equipped with 4 speed changer mechanisms 78, 45, 33 1/3 and 16 2/3 r.p.m., will remain up-to-date and protect your precious records for many years to come.

The unit incorporates the same features as the existing **Monaural Changer unit TW1561,** with the exception that it is equipped for stereo operation, and is fitted with the turnover type Crystal Cartridge.

Also available Model TW1561 Chassis — 4 speed for monaural operation — fitted with ceramic cartridge.

Retail _____ **£26**

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CHANDLERS

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WHISKERS MAK SUPER METALS

(Continued from Page 11)

scientists are trying to grow bigger better whiskers of super-strong m while others are desperately trying prevent them.

For the original nuisance still rema and short circuits are still liable to o because of it. It may even be that purities in metals, or selected alloys grow fewer crystals than pure meta

If research should solve the two p lems, one of how to prevent whisk and the other of how to grow t quickly in larger numbers, and greater size, what is now a fascina phenomenon may confer great benefi widely different spheres.

NEW USE FOR DRY RECTIFIER

(Continued from Page 23)

Although the cost of the contro solid state rectifier is high, figures s that it offers a number of advant over other devices. These include a efficiency—99 p.c., long life—up 100,000 hours, and a wide tempera operating range—from minus 65 to 125 degrees Centigrade. In addition, size and weight per Kw are descr as "very low."

On the debit side is a present of between 10 and 50 Kw power h ling capacity, which is low compa with other devices. However, larger are visualised with ratings in the 10 Kw range, and with life expectancy ceeding 100,000 hours.

How to get you amateur licence

(Continued from Page 61)

the plate circuit is tuned. Under t conditions the stage is neutralised.

If the valve is not neutralised t will be regeneration in the circuit to energy from the plate circuit b fed back into the grid circuit thro the internal capacitance of the valve, oscillation will almost certainly place. Neutralisation feeds some ou from the final tank back to the gri opposite phase, and when the two c ponents balance the valve is neutral and no positive feedback occurs.

READER BUILT

(Continued from Page 63)

90 turns, jumble found to approx 1 width. The regeneration coil req 15 turns if OC44 is used and 20 tur OC45 is used. It is also jumble wou

Mr Haskard does not mention the meter and length of the ferrite rod we assume he has in mind one of standard ferrite rods used for broa portables which is 8in long and 3 diameter.

THE APOTHECARY HAS AN ANCIENT HISTORY

(Continued from Page 19)

escribed will provide the exact quantity drug he thinks will be effective.
That is why one person will not neces-ily be relieved by the same medicine taken by another with similar symp-ns. In fact such a procedure can be finitely dangerous.
There are many diseases which cause nilar symptoms but which may be quite ferent in nature. Some people require s of a given drug than others and some quire more. Some are sensitive to rtain drugs like penicillin or sulpha ugs which produce severe skin irrita-n in some people.
Dosage is determined by the weight of e patient, sex, time of administration, e and so on. Even colour of hair or n is often taken into consideration.
Having arrived at the appropriate pre-iption the doctor sets about writing it wn so that the chemist can understand

SE OF LATIN

It is a common fallacy that doctors ite prescriptions in Latin just to keep e patient ignorant of the contents. Such not the case.
The use of Latin in writing prescrip-ns has several advantages. Firstly, be-use Latin is a dead language, the eaning of Latin words is not continual-changing. Then again the Latin names drugs are quite definite and do not d themselves to misinterpretation. tin is the universal language of medical ence throughout the world and a pre-iption written in Latin by a Greek ctor can be as readily understood by Chinese doctor.
However, despite these advantages it fast becoming a practice to write pre-iptions in the language of the country ere they are written.
A complete prescription consists of a perscription, an inscription, a subscrip-n, a signa or mark and the name of writer in that order.
The superscription consists of the pati-'s name and address or other relevant rticulars.
The inscription or body of the pre-iption gives the ingredients and the ounts to be used of each drug.
At the beginning of the inscription is ually a symbol R.

YSTIC SYMBOL

This is the sign of Jupiter, the god of ding, which has been handed down ough the ages. It is now taken to an "Take Thou" as derived from the in word "recipe." Thus it is a direct er from the doctor to the pharmacist l the latter has no power to alter the scription unless with permission from writer of it.
The subscription is a direction to the rmacist as to how the mixture is to compounded, but owing to the wide wledge of the present-day pharmacist s getting more and more simple, the d "misce," meaning mix, being all t usually appears.
The signa or mark are directions to patient as to how the prescription o be taken and is usually written on label in English.
The writer's name is an important part he prescription, because it guarantees authenticity of the prescription.

Where a prescription is a complex one the inscription is usually divided into four parts, namely: The base, or principal ingredient, which is intended to exert the greater activity of the prescription.

The adjuvant, which is used to either enhance the activity or mask the taste of the main substance and make it more palatable.

The corrective, which is added to correct any side reactions which may result from the base.

The vehicle, which makes up the volume and enables the mixture to be measured by the patient for the dosage.

Thus the pharmacist, when he has to compound a prescription, must bring to bear all his knowledge which he has gained through intensive study.

One of the main things which the pharmacist must guard against is the mixing of drugs and chemicals in such a way as to form other chemical compounds which would be dangerous to the patient. He must understand the principle of incompatibility.

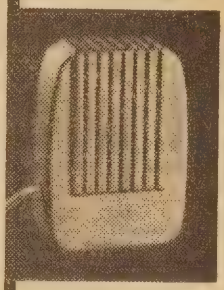
There are three types of incompatibility. Firstly, physical incompatibility, which occurs when some change in the mixture produces cloudiness or other unsightly phenomena.

Chemical incompatibility occurs when a new compound results from the mixture of two or more different drugs or chemicals.

INCOMPATIBILITY

Therapeutic incompatibility occurs when drugs are mixed which have opposite physiologic actions. Overdoses or dangerous doses of drugs may result from therapeutic incompatibility. However, sometimes therapeutic incompatibility is deliberately used to counter a too-decided action of one drug or to offset undesirable side effects.

If the pharmacist didn't know his job he could cause explosions by incorrect mixing of chemicals. He could cause serious injury to the patient by wrong quantities of drugs. He could cause death by the same means. In other words, the pharmacist is a highly trained scientist who never does these things. He is one in whom the public must have the utmost faith. Perhaps more than any other person in the world he holds the health and lives of the individual in his care.

AWA RONETTE
MICROPHONES & ACCESSORIES

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THESE NEW DUAL WAVE RADIOGRAM CHASSIS MADE BY LEADING MANUFACTURER ARE EQUIPPED WITH LATEST MINIATURE VALVES AND SUPPLIED WITH 12in ROLA SPEAKER.

£17/15/-

F.O.R. PACKING 10/ EXTRA

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20 for	20/-	EF50, 7193, 954, VR65A. Post and Packing 6/6 extra.
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8 for	20/-	6SH7, 7C7, 1J6.
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4 for	20/-	6U7G, 6J7G, 6SS7, 7C5, 2X2/879, 84, 1T4, 41, EBC33/6B6G, 6U5G.
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ALL VALVES ARE NEW AND MOSTLY IN INDIVIDUAL CARTONS

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Ceramic EF50 sockets 2/6 ea. American moulded Loctal 1/ ea. Octal 8 pin wafer 6/6 doz. Aphanol 5 pin ceramic 2/6 ea. Aphanol small 7 pin ceramic 2/6 ea. All post extra.

NEW RECORD PLAYER

4-speed B.S.R. Player with Turnover Crystal Pick-up and Amplifier in attractive Two-tone Cabinet.

£18/15/-
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American handy talkies. Good condition, supplied with valves, coils and crystal.

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MATCHED SET OF CRYSTALS AND COILS FOR 536 TRANSCEIVERS. £2/10/.

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A.W.A. Oak 6V. 7-pin synchronous.
5/ ea. or 48/ doz.

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High impedance S.T.C. headphones, good order.
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FOR THAT C.R.O. or T.V. SET

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NEW 5BP1	37/6	N.S.W. 11/; Int. 15/
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I.R.C. 50 ohm 25 watts, 8/6. Post. 1/.

NEW VALVES AT BARGAIN PRICES

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6J6	12/	6K8G	9/6	1P5G	5/	6H6	2/6
ECH 35/VR99A. Direct replacement for 6J8G	10/	6SJ7GT	9/6	1C7G	5/	6H6GT	1/6
		12K8	10/	1K5G	2/6	6K7GT	7/9
1C4	7/6	6AC7	2/6	1M5G	5/	6U7G	6/6
1L4	4/6	EK32	10/6	1K7G	5/	6J7G	5/
1T4	7/6	6SA7GT	9/6	1L5	9/6	7C7	3/6
1S5	10/	6SH7	5/6	6AC7	2/6	78	7/6
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EL32	10/6	811	£1
6V6GT	12/6	12SH7	5/
VR65A	2/6	6K7G	4/6
41	7/6	1C6	7/6
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Please add postage on all valves.
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("Mercury" American Made). These relay counters register from 0 to 99,999, can be supplied with 250-ohm coil 24v D.C. operation.

25/-
Plus Postage.

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25/-
Post extra on Command Equipment.

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WITH VALVES AND CRYSTAL
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4 equals 5.3 Mcs., or 5.3 equals 7 Mcs.

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Bakelite hand microphone with switch.
15/. Post 2/6.
Used, but in good condition.
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809	5/6
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803	17/6

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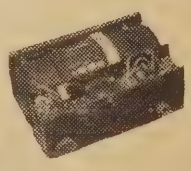
SPARK PLUG SUPPRESSORS

Kit of 6 plug and distributor suppressors. 10/

NEW S.C.R. 522 GENEMOTORS



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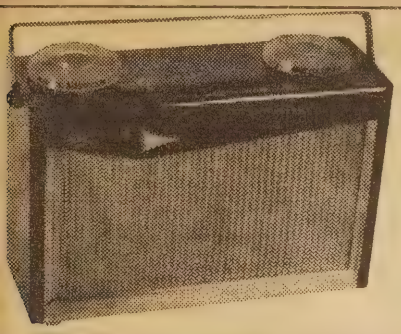

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£26/10/-

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SET WIRED AND TESTED £2 EXTRA

Including 6 S.T.C. Transistors, R.C.S. Coilkit with printed circuits, Rola Transformers and 5F Speaker and all parts necessary to complete this Set including attractive and durable two-tone cabinet with gold trim.

Weight 11lb.
Cabinet size 13in x 10in x 6in.

PORTABLE TRANSISTOR RADIOGRAM

Complete Transistor Six kit with B.S.R. four-speed motor and crystal pick-up and attractive two-tone covered cabinet **£35**

As above, but with Seven Transistor kit.

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7 TRANSISTOR PORTABLE

Specifications as above but with extra I.F. stage, giving better range and selectivity; also has extra coil for connecting to car aerial, making it ideal as a car set or for country locations.
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£29

Post Extra.

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omplete kit of parts for the car radio as featured in the June issue of R., TV. and H. Parts, including valves, transistors id speaker, £28/15/-. Post extra. Wired and tested, £4 extra.

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100 for 25/-

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Westinghouse 1 mA rectifiers, 15/.

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New Dubilier pigtail condensers.

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100,000 ohms	100,000 ohms.	100,000 ohms	100,000 ohms
500,000 ohms	500,000 ohms	500,000 ohms	500,000 ohms
1 meg. ohm		1 meg.	1 meg. ohm
4/6 ea. 42/ doz.	2/6 ea. 24/ doz.	3/6 ea. 33/ doz.	1/9 ea. 16/ doz.

500,000 ohm pots can be supplied tapped at 40,000 if required, post extra.

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1¾in diam., ¼in shaft, 42/ doz.
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3½in. diam., 3/8in shaft, 66/ doz.
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BC 906/D. 15 to 23 Mcs.

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Complete with tubing.

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Ex-Army, LUMINOUS. Guaranteed Correct.

£7/15/- each

Post: N.S.W., 3/; Int., 4/.

BLOWER MOTORS

Miniature 12v, 24v variable (American), 39/6 ea.

Post: N.S.W., 4/2; Interstate, 5/7.

VOLTMETER

Pocket Size.

0 to 15 volt D.C. and 0 to 220 volt D.C., with probes. In waterproof Canvas Case.

33/6 each

Post: 3/4; Int., 4/6.

DIRECTOR DUMPY LEVEL WITH TRIPOD.

£22/10/- each

Freight payable at nearest attended railway station.

CRYSTALS

New in the following frequencies: Kc's. 5397.5, 5852.5, 5205, 5660, 4840, 5295, 4495, 4950, 5327.5, 5782.5, 4397.5, 4852.5, 5780, 6235, 5920, 6375, 25/ ea., complete coil and crystal units for walkie-talkie (SCR536), new £2/10/ per set. Add postage.

MAGNETO

Ex-R.A.A.F. Complete.

12-cylinder, platinum points, adaptable to 4, 6 or 12-cylinder marine, car or tractor engines.

£4/10/-

Freight payable at nearest attended railway station.

RECTIFIER

RA88A new, contains 3 valves 6L6, 3 valves 5T4, 2 valves, 150/30, 1 valve GSL7GT, trannie, chokes, aluminium chassis.

£4/15/-

TELESCOPES EX-Army

Ottway of London.

With variable power adjustments. Length 26in. Weight 12lb

£12/10/-

Freight payable at nearest attended railway station.

CHASSIS

RT24, TN, B/APX1 with 20 miniature seven-pin ceramic valve sockets and covers, chokes, etc.

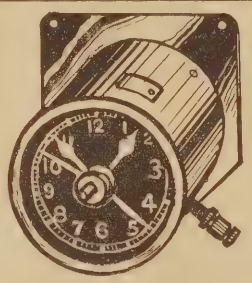
45/- ea.

GUNSIGHT COLLIMATOR

Contains Acromatic Lens, 1 7/8in diam., 4½in F.L., front silvered diagonal elliptical mirror, two worm traversing gears, sundry tubes, connector mirrors, etc.

27/6 ea.

Post: N.S.W., 3/11; Int., 6/3.



AIRCRAFT CLOCKS

SMITHS 8-DAY, **£3/19/6**

Ex-Rolls-Royce Merlin, with sweep second indicator, **ELGIN**

£6/10/-

Post: 3/1; Int., 4/3.

VALVES, NEW

1R5 ..	12/6	6AG5 ..	7/6
1T4	10/	9006 ...	15/
3A4 ...	12/6	837	9/6
6C4	7/6	83	9/6
6J6	15/		

B.T.118 transmitter valve £3/10/ ea. Add postage.

DRIFT SIGHT

Canada Mk. II contains these lenses: 2 acromatic 1¼in diam., 5in focal length, 1 Bi-convex 2in diam., 9in focal length, 1 plane convex, 2in diam., and 9in focal length, 1 small elliptical mirror, minor axis 1 7/16in. 1 flat optical front silvered mirror, 1¾in x 2 7/8in. 1 4in ground glass disc and sundry parts, etc. 42/6 ea.

Post: N.S.W., 5/11; Int., 9/3.

HEADPHONES

High Impedance. Suit Crystal Sets. Lightweight. American.

22/6 pair

Post: N.S.W., 2/1; Int., 3/3.

AIR SPEED INDICATORS

NEW.

8/6

Post: N.S.W., 2/1; Int., 3/3.

WALKIE TALKIE BATTERIES

Suit CSR 536.

One H.T. 103½, one L.T. 1½V.

15/- pair

Post: N.S.W., 3/2; Int., 4/7.

MANIFOLD PRESSURE or VACUUM GAUGE

£1 each

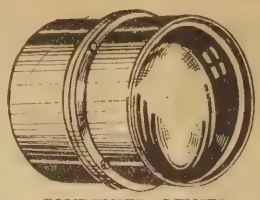
NEW.

Post: N.S.W., 2/1; Int., 3/3.

AUSTER MOTOR

1/25 H.P. continuous duty 5600 r.p.m. Ideal for use on 32v lighting plant. £4/15/.

Post: N.S.W., 5/11; Int., 9/3.



CONDENSER LENSES, 3½in WITH CELL.

£3/15/-

Reflector Mirror, Lens, Lamp-holder, 35/ extra.

Post: 4/2; Int., 5/7.

RANGE FINDERS

Horizon and Bubble Type. Mark IIIB.

Complete with Leather Case.

Dimensions, 9in x 4in x 2in. Ex-R.A.A.F.

ORGINAL COST, £30.

PRICE 35/-

Post: N.S.W., 3/2; Int., 4/7.

TRANSFORMER AND RECTIFIER UNIT

Ideal for relay operating. Input 10v, 240v A.C., Output 241, 57v, DC

35/-

Post: N.S.W., 4/11; Int., 7/3.

No. 19 TRANSCEIVERS

(Two-way Radio). Complete with power pack, junction box, leads, etc. £15 each.

WHIP AERIALS

Ideal for car or TV antennas or blackfish rods. 13ft in 12in sections.

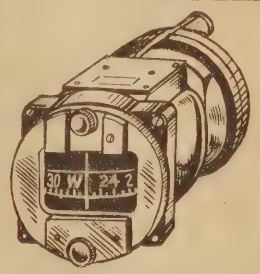
19/6

Post: 1/9; Int., 2/9.

GEARED MOTOR

Genuine Auster variable 12/24v, type B/9/1, 7 amp. Motor r.p.m. 5600, but geared down r.p.m. output is variable, 6 to 20, 57/6 ea.

Post: N.S.W., 5/11; Interstate, 7/3.



Dashboard COMPASS

Small ships. Pioneer American. Liquid Damped with Light. Also suit as car compass.

£7/15/-

COMMAND RACKS

Receiver 3 tier, 19/6 ea.
Transmitter, 1-tier, 12/6;
2-tier, 15/ each.

Post: N.S.W., 2/3; Int., 4/3.

CHASSIS

RT24/APX2 15 miniature seven-pin ceramic valve sockets and covers. trannies, etc.

45/- ea.

BOOSTER COILS

For racing enthusiasts. 12V. Bendix, new type 512. Platinum Points.

22/6 ea.

Post: N.S.W., 2/1; Int., 3/3.

SEARCHLIGHT REFLECTOR MIRROR.

3ft PARABOLIC. Ideal Solar Heat experimenters, Hot-water systems, etc. Also makes splendid Wall Mirror, especially when Fish Bowl or Flowers are placed in front. Has pleasant reflections effect. Original cost, £80. SPECIAL PRICE,

£5/15/-

Sorry, no mail this line.

SINGLE GANG VARIABLE CONDENSERS.

10/-

Post: N.S.W., 1/10; Interstate, 3/

Mechanical REV. COUNTERS

BENDIX.

New, 0 to 3000 r.p.m.

£4/19/6 each

or complete with flexible drive.

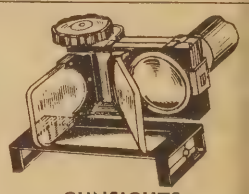
£6/15/-

Post: N.S.W., 3/; Int., 4/6.

MODULATION TRANNIE

and driver (522, 160 and 116), 45/

Post: N.S.W., 5/11; Interstate, 7/



GUNSIGHTS

Contain these lenses:
1 Lens 1" Focus, ½" diam.
1 Lens 1 11/16in Focus, 1¼in dia
1 Air Spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule.
1 Lampholder.

18/6 each

Post: N.S.W., 2/1; Int., 3/3.

FIELD STRENGTH METER

OUTFIT 1E/18/A
BRAND NEW.
COMPLETE.
100 to 155 Mcs.

With 0-1 internal/external shu meter, tools, battery box, sign generator and instruction book i dovetailed wooden case.

£17/10/-

Freight payable at nearest attende railway station.

WALKIE TALKIE 2-WAY RADIO

Complete with tank coil, crystals and batteries.

£7/19/6

Post: N.S.W., 4/2; Int., 5/7.

522 TRANSCEIVER

Complete £12/10/; 522 Transmitt £6/15; 522 Receiver, £6/15/; 522 Chassis.

45/-

TELEPHONE CABLE

BRAND NEW, NYLEX ROTPROOF COVERED.

£4/17/6 per mile

Freight payable at nearest attende railway station.

DEITCH BROS.

70 OXFORD STREET, SYDNEY

Between Crown and Riley Streets, City.

ANSWERS TO CORRESPONDENTS

F.T. (Waikato, N.Z.) asks about switch ircuits which allow a single meter to be as both a voltmeter and an mA meter and about the differences between an oscillator signal generator.

It is quite easy to add resistors in series rallel with a basic meter movement, say 100 ohms, to read 1 volt, 3 volt and nA as you suggest. In fact, switching cir- to permit these sort of readings are in- in an ordinary multimeter. If it is re- to use the meter as a tuning indicator, sual procedure is to shunt it appropriately nA is often a convenient figure for mains- ed sets) and connect it in series with the tension supply to one of the valves con- by AVC. As the signal strength increases, urrent drawn by the valve decreases and the indication of the meter. In the generally ed sense, an oscillator is a simple instru- with a minimum of controls, while a generator includes an accurate attenuator meter check on the ouput and is con- d to better standards generally. There is ar dividing line between the two.

T. (Coogee, N.S.W.) writes to comment on ories in the Serviceman columns concerning owth of silver between valve pins, and to is own account of a similar trouble.

Many thanks for your letter, P.B.T., and ll pass this on to the Serviceman for his e comments in a future article.

(Haberfield, N.S.W.) asks some questions magnetism, gravitation and the possible use ltage doublers in crystal sets.

We would not be able to give a very ensive reply to your queries in these col- and therefore we are holding your letter ssible future use in the "Here's Your An- Tom" feature.

(Cabramatta, N.S.W.) is interested in be- a radio amateur and asks about suitable ations to study, how to learn code, the riate authority to contact and finally if- are any amateur clubs in Sydney which he in.

About the most generally useful publica- s The Radio Amateur's Handbook, pub- by the American Radio Relay League, but are others which you will find listed in ficial P.M.G. recommendations. Some in- ion on learning code is included, but for e detailed treatment we suggest Learning adio Telegraph Code, published by the same ation. Both should be available from Aus- technical booksellers. For full details of the ments, including copies of back examina- apers, you should contact the Radio Branch P.M.G.'s Department. From time to time. answers to amateur papers are published in Television and Hobbies. Back copies ng the more recent ones are sometimes le. The Wireless Institute of Australia icularly keen to help prospective amateurs u would be eligible to join as an associate. for both theory and code practice are gularly, while a correspondence course is e for those who cannot attend. Further tion can be obtained from the secretary, 34, G.P.O., Sydney.

(Pt. Noarlunga, S.A.) encloses a sugges- r making a socket to fit some of the in-type cathode ray tubes, which he con- may be of interest to the "Reader Built te.

Many thanks. We will keep your idea l.

W. (Townsville, Q.) writes to suggest that t some data concerning transistorised flash nainly for the benefit of servicemen.

Many thanks for the suggestion, M.C.W., your kind remarks about the magazine. ve not had much chance to investigate nits yet, but we have not been particularly ed by what we have seen. It apparently en necessary to sacrifice performance con- y (in spite of the optimistic joule ratings either in the interests of portability or r life, and the effective light output is mpared to other units. We assume that would be available from the agents for efit of legitimate servicemen.

. (The Entrance, N.S.W.) submits a cir- a stereo balance indicator and goes on an appreciative comment on our journal.

Many thanks for the comment, R.J.A. Your has been passed on to the member of responsible for the "Reader Built It" for possible future inclusion.

. (Mooroolbark, V.) is puzzled by the of Channel 2 sound signals on a small e receiver, located about three miles from smitter.

We would say this was fundamentally a force" effect, whereby the signal is so s to force its way through the receiver obably due to its strength, create some n approximating the "slope detection" sys- FM reception. The distortion would to the crude nature of this circuit in the ther than any interference from the video

. (Canterbury, N.S.W.) writes to suggest describe a simple fixed tuner to receive I-2SM stereo broadcasts.

Many thanks for the suggestion, W.S.F., and we will keep this idea in mind. However, there is some doubt as to whether very much would be saved, apart from the gang and dial, and a fair amount of money would be invested in a unit with limited application. Also (probably since your letter was written) 2FC and 2BL have entered the field, adding one more complication.

P.M. (Toowoomba, Qld.) asks if germanium diodes may be used in place of valve diodes in ordinary radio receivers. He has found that the germanium diode gives more volume in a crystal set. Also he asks if negative feedback could be used to improve signal-to-noise ratio when receiving interstate stations.

A. Germanium diodes may be used in broadcast receivers in place of thermionic diodes provided the circuit is specially designed to suit. Usually it costs so little extra to place a diode in a valve which also has amplifying elements that the germanium diode is more costly. The reason that a circuit change is required is that the germanium diode does not have an infinite resistance in a reverse direction and therefore a lower impedance circuit is required to take advantage of the lower forward resistance. It is this lower forward resistance which makes for better rectification efficiency and hence better volume in the headphones of a crystal set. The back resistance is usually still high compared with the resistance of the phones. Negative feedback on the radio frequency stages would not be of benefit to you in receiving weak stations. In the audio stages it may be used to provide a more favourable response characteristic, but this is too involved a subject to discuss here.

I.B. (no address) asks if it is possible to modify a transistor radio to receive on long wave.

A. Yes, it is possible to modify most receivers to operate on long wave, but there are many cases where it is not very practical because of cost or because there is no space for the additional components. The long-wave band (200 kc) is not used for broadcasting in Australia, but it has been used in Europe, where many sets are designed so that it is easy to switch to either long or medium wave stations.

R.D.W. (Peat Island, N.S.W.) forwards the story of how he constructed a cheap stereo amplifier set-up using two old radio chassis with the idea that it might be of interest for the "Reader Built It" page.

A. Many thanks for your contribution, and as you say there may be other readers interested in the ideas. We feel, however, that the written information would be of more value if it were accompanied by diagrams. Would it be possible for you to let us have the circuit diagram of the complete amplifier system?

M.C.G. (Coburg, Victoria) forwards a query seeking further information on one of "Answer Tom" queries featured recently.

A. Thank you for the query and the suggestion, M.C.G. We shall file your letter with a view to using it at the earliest opportunity.

G.T.G. (Carlisle, W.A.) has tried to build a simple 50 Mc receiver from an overseas magazine, but is not having a great deal of success.

A. Since we have no details of the circuit you are trying to use, G.T.G., it is virtually impossible for us to help you. However, we imagine the set is one of the super-regenerative type and these, while capable of outstanding performance, are quite critical in the matter of component values. In addition, they cause serious interference in whatever band they operate on, and we imagine you may not be very popular with the taxi company on whose band you are operating.

B.H. (Richmond, Vic.) has built the stereo amplifier of July, 1958, but substituting 6BM8s for the 12AX7/EL84 combination. He is now worried by lack of bass and the effect of a 2 ohm voice coil on the feedback network.

A. As you probably can appreciate, the amplifier is now so far removed from the original design as to be almost unrecognisable. The only way we could offer any advice would be to completely design such an amplifier ourselves and iron the problems out by experiment on the bench. Since this is quite beyond the scope of our service, we regret that there is very little we can do to help you.

J.C. (Fivedock, N.S.W.) wants to build a stereo radiogram and wants to know if we can recommend a suitable circuit.

A. Much depends on the standard of equipment you require, J.C., but we would suggest the Stereo Radiogram of April, 1959. Back copies of this issue are available if required.

R.S. (Tooraweena, N.S.W.) wants to know why we specify resistance and capacitance values in the odd figures of 33, 47, 68 etc instead of the even figures of 30, 50, 70, etc. He suggests it might be because we know he has a stock of the latter values and simply want to be contrary!

A. No R.S., we are not simply trying to be contrary, nor are we trying to appear ultra accurate. We use these values for the simple reason that they are standard values. Try buying a 50,000 ohm resistor these days and you will find you will either have to be satisfied with a 47,000 ohm or place a special order. Its a long story R.S. and a fairly old one now but, briefly, the "preferred values" (as they are called) were adopted so that each value represented a definite percentage increase over the previous value. Three sets of values are used, having separations of 20 per cent, 10 per cent, and 5 per cent, and the lower ones fit nicely in between the higher ones. The scheme ensures that an adequate range of resistors may be stocked with a minimum number of values and saves a great deal of time and storage space. However, there is no reason why the older values may not be used in place of these, since the difference normally amounts to only a few per cent. The whole subject was covered very thoroughly in the "Argument" section for July, 1956 and you may be able to refer to this issue.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

LATEST RELEASES by FERGUSON

MULLARD "2-STEREO-2" AMPLIFIER

POWER TRANSFORMER—PF1428
PRIMARY— 230, 240, 250V, 50 cps
H.T. SECONDARY—250-0-250V, 80mA
L.T. SECONDARIES—6.3V-2A, C.T., 6.3V-0.6A

OUTPUT TRANSFORMER—OPM20
(STANDARD MEDIUM FIDELITY)
NOMINAL POWER RATING—5 Watts
FREQUENCY RESPONSE—40-12,000 cps±2db
PRIMARY. IMP—10,000, 8,000 ohms S.E.
SEC IMP.—15, 12.5, 8, 3.7, 3.1, 2 ohms

R. T. & H. DISTORTION METER

AUDIO FILTER CHOKE—CF433
INDUCTANCE (At 1 Kc., No D.C.)—20 henries
D.C. RESISTANCE—510 ohms
Use Power Transformer Type PF201

STEREO AMPLIFIERS, ETC.

FILTER CHOKE—F2-150
INDUCTANCE—2.5 henries
D.C. CURRENT RATING—150 mA
D.C. RESISTANCE—125 ohms

NEW POWER TRANSFORMERS

POWER TRANSFORMER—PF1459
PRIMARY—230, 240, 250V, 50 cps
H.T. SECONDARY—250-0-250V, 60mA
L.T. SECONDARIES—6.3V-2A C.T.
6.3V tapped 5V-2A.

POWER TRANSFORMER—PF1460
PRIMARY—230, 240, 250V, 50 cps
H. T. SECONDARY—250-0-250V, 80mA
L.T. SECONDARIES—6.3V-2A C.T., 6.3V-2A
6.3V tapped 5V-2A

R. T. & H. 110 deg. TV RECEIVER

POWER TRANSFORMER—PF1448
PRIMARY—230, 240, 250V, 50 cps
H.T. SEC.—TO SUPPLY 260V @ 300mA
AFTER FILTER
L.T. SECONDARY—12.6V-5A C.T.

SPEAKER TRANSFORMER—OPS1
PRIMARY IMPEDANCE—7,000 ohms S.E.
SECONDARY IMPEDANCE—3 ohms
Use Filter Choke Type FI-285

R. T. & H. 1959 KARSET

TRANSISTOR DRIVER TRANSFORMER—TRD124
(ORIENTED GRAIN STEEL LAMINATIONS)
PRIMARY IMPEDANCE—8,000 ohms S.E.
SECONDARY IMPEDANCE—20 ohms

TRANSISTOR OUTPUT TRANSFORMER—TRS120
(ORIENTED GRAIN STEEL LAMINATIONS)
PRIMARY IMPEDANCE—20 ohms S.E.
SECONDARY IMPEDANCE—3.5 ohms

LOW TENSION FILTER CHOKE—CF435
INDUCTANCE—APPROX. 30 mH
D.C. CURRENT RATING—1.25 amps. max.
D.C. RESISTANCE—0.3 ohms

R. T. & H. 17W STEREO AMPLIFIER

POWER TRANSFORMER—PF1193V
A vertical mounting version of the well-known PF1193 TV Power Transformer
PRIMARY . . . . . 200, 220, 240V 50 cps
H.T. SECONDARY . . . . 295-0-295V 275 mA*
L.T. SECONDARIES . . 6.3V-9A
6.3V tapped 5V-3A
* For amplifier use H.T. current may be increased to 300 mA.
Use Filter Choke Type FI-285 and Output Transformers Type OP297

Manufactured by

FERGUSON TRANSFORMERS PTY. LTD.

FERGUSON LANE, CHATSWOOD, N.S.W. JA8491.

O. **(Toorak, Vic.)** is one of our younger s (14 years), who is anxious to contact other readers interested in radio construction. he aim of exchanging ideas.

Many thanks for your comments about the ne, J.R.O., and we have taken the liberty nting your full name and address at the end s reply. Anyone interested may then con- ou direct. J. R. Orr, 9 Rathmines Street, . S.E.2.

D. (Hollywood, W.A.) writes to draw our on to a report in the "Amateur Bands" page ning a solar powered transistor transmitter ping 75 million watts. He asks—a trifle ically we feel—whether this constitutes some of a record or rates some kind of certifi-

lt probably would if it was fair dinkum, , but, as you have obviously guessed, that ot what was meant. Apparently our lino- perators and proof-readers cannot appreci- e fine distinction between "milli-watts" and on watts"—with disastrous results. Then it may have been our correspondent's writ- Thanks, anyway, for drawing our attention we will try to be more careful in future.

.M. (No Address, Melbourne, Vic.) is s to obtain circuits which might be suit- or use in a hobbies group to introduce members into radio, commencing with crys- s and progressing to larger sets.

We would have replied to you direct, ., but the omission of an address prevents We can provide a wide range of circuits g almost any type of receiver from the set up, but we doubt if this would be nt for what you have in mind unless there eone available with a fair amount of ex- ce to interpret these and guide the builders early stages. We have published a series icles at various times somewhat along the ou suggest, but copies of the complete ar- are no longer available from this office. We nly suggest that you may be able to refer n at your nearest large public library. Suit- eferences would be: Teach Yourself Radio, ncing October, 1952; Simple Course in commencing January, 1957 (a few copies still available, but no complete sets), and es commencing in June, 1956, describing age by stage construction of four-valve set (Little General).

.H. (Milson's Point, N.S.W.) asks if we pply copies of the August, 1945, August, and December, 1954 issues.

No. D.R.H., we regret that we cannot supply te issues as far back as that. We still opies of most issues published in the last of years, but the demand on earlier issues mpletely exhausted our supplies. On the nand, we can supply copies of the circuits, f most amplifiers, receivers, etc., published he last 20 years.

(Avondale, Auckland, N.Z.) asks why we AVC on the converter in some of our ave sets if this practice aggravates oscilla- ft with fading?

Without making a careful check through ircuits, we could not give you a detailed of motives for so doing. Far and away st important ones, however, would be pre- ed coil units which are already wired that nd bias systems which may make it diffi- do anything else. Another point is that onverters are better than others in this re- nd oscillator shift with AVC is not so a problem. Your other points have been d in the "Argument" pages.

K. (Yannathan, Vic.) is anxious to obtain ress of a Melbourne firm, American Gad- r. Ltd., and appeals to us for assistance.

orry we cannot help directly, W.A.K., ave no knowledge of the firm or whether, suggest, they may have gone out of busi- owever, if any other reader is able to may care to write to you direct, and taking the liberty of publishing your full nd address: Mr W. A. Kerr, c/o But- tory, Yannathan, Victoria.

. (Manangatang, Vic.) is interested in a personal portable type receiver, based Four Transistor Superhet of May, 1959. our advice regarding some changes he mind.

e are not quite sure what you are try- chieve, G.H.J., but we gather you intend itute variable reaction for the fixed ar- it, and to eliminate the volume control. no reason why the present circuit should used as a variable reaction system, pro- e operator is prepared to use the addi- ontrol correctly. However, the omission volume control would not be desirable, often is necessary to reduce volume aining the maximum regeneration to pre- ectivity.

. (Perth, W.A.) is interested in methods g paper and electrolytic capacitors. He know if a megger can be used in ication.

should be possible to check the leak- aper capacitors using a megger, but this ot be suitable for checking capacitance olytic types. In fact, the latter present ecial problems, and we have never de- quipment to test them. The R/C Bridge in September and December, 1958, is f checking both leakage and capacitance pes other than electrolytics. Copies of ues are available if required.

. (Alectown, N.S.W.) is worried about o meters caused by overload, and wants to know if it is possible to use a fuse to provide protection.

A. In general, H.W.U., this is not practical, since the fuse would have to be extremely fine in order to offer any worthwhile protection. A torch bulb would be far too heavy to be of any use at all. The most promising approach to the problem appears to be the current one of using non-linear resistors of some kind across the meter to provide a heavy shunt whenever the voltage rises substantially above full scale value. However, we have no details of specific types which may be available locally.

D.R.B. (Seaford, Vic.) writes to the Serviceman to express his appreciation of these articles and to relate some similar experience in his own service work. These vary from the recent "exploding" cathode by-pass (July issue) to a repeat of the now classic story story the character who lubricated his speaker with glue.

A. Many thanks for the comments, D.R.B., and we will pass your letter on to the Serviceman. We feel sure he will appreciate it, particularly the story about the speaker and the electrical appliances. As you say, some people seem to take fantastic risks with appliances, and we can only hope we can do our part in educating them.

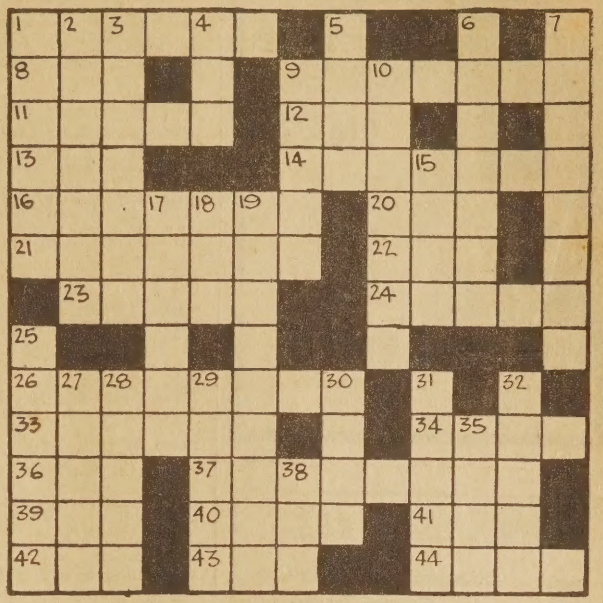
C.H.W. (Dalkeith, W.A.) writes to suggest that we describe a transistorised electronic flash unit.

A. We are keeping our eye closely on this position, C.H.W., and we are well aware of the type of commercial unit available. However, we are not particularly impressed by these, since it appears that they achieve most of their reduction in size, weight and cost, only at the expense of light output, most of them being in the region of only 20 joules.

J.B.S. (Leongaha, Vic.) has an old power transformer without HT markings and wants to know whether we can identify it and whether it could be used for the Three Band Three.

A. We cannot identify this transformer positively, but, judging from the age of the set, it is most likely one of the 385 volt types. More positive identification might be possible by reference to the service department of the manufacturer concerned. Such a transformer can be used for the Three Band Three, but something like 235 volts will have to be wasted across a resistor. Such a resistor may be located between the rectifier cathode and the first electrolytic, where it will be most effective, and we suggest a value of about 4000 ohms as a basis for experiment. Such a resistor will have to dissipate approximately 7 watts and a rating of at least 10 watts should be used, but preferably 20, particularly if it is enclosed in any way.

THE R., TV & H. CROSSWORD No. 65



ACROSS

ACROSS

1. The ion in an electrolyte.
8. Regret.
9. Concentric cable.
11. Serpent.
12. Ancient.
13. Seven (Latin).
14. Atomic heat generator.
16. Vulcanite.
20. Hawaiian dish.
21. Water gates.
22. Metal.
23. Girls' name.
24. Musical instrument.
26. Unlimited.
33. An American tropical bird.
34. Boys' name.
36. Belonging to him.
37. A metallic element.
39. Compass point.
40. Beverages.
41. Institute of Radio Engineers (abbrev.).
42. Colour.
43. Pounds, shillings and pence (abbrev.).
44. Duty imposed by another.

DOWN

1. Desired strongly.
2. Able to be heard.
3. Protracted.
4. Belonging to us.
5. Measure of length.
6. Raising one end.
7. Rendering indistinct.
9. Parts of magnetic circuits.
10. Devise for the interchange of lenses in a camera.
15. Rope from coconut fibres.
17 Powerful acid.
18. Congealed water.
19. Point of connection.
25. Musical instrument.
27. Harsh sound.
28. Melted.
29. Relating to birth.
30. Consumes.
31. Crack.
32. Vapours.
35. Atmosphere.
38. Boys' name.

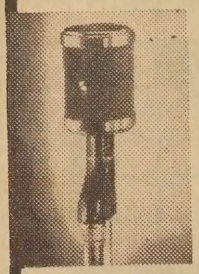
Solution and further crossword next month

Last month's solution

H	I	L	L	A	N	D	D	A	L	E		W		
A		O		C		E		I		Q		A		
R	E	F	L	E	X	C	I	R	C	U	I	T		
M		T		T	R	O	T	S		I		T		
O			S	A	A	R			O	V	A	L		
N	I	N	E	T	Y			D		A		E		
I			L	E			C	A	B	L	E	S		
C	O	M	E	T	S		O	B	O	E		S		
			C	A	K	E	S		A	N	T			
P	O	R	T	P	I	R	I	E		T	I	N		
	G		I	E		G	N	A	T	S		E		
S	L	A	V			S	E	T				A		
	E		E	T	A			S	H	U	N	T		

AWA RONETTE

MICROPHONES & ACCESSORIES



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